FACTORS OF EFFECTIVENESS IN SCIENCE TEACHING AND THEIR APPLICATION
TO THE TEACHING OF SCIENCE IN OHIO'S PUBLIC SECONDARY
SCHOOLS

DISSERTATION

Presented in Partial Fulfillment of the Requirements
for the Degree Doctor of Philosophy in the
Graduate School of The Ohio State
University

Volume I

By

WARREN MAYWOOD DAVIS, B. A., A. M.

The Ohio State University

1952

OHIO STATE
UNIVERSITY

Approved by:

Adviser

ACKNOWLEDGMENTS

I wish to acknowledge with thanks the assistance which has been given by so many people in the preparation of this dissertation and in the study which led to it. While it is not possible to name all of those who helped, the contributions of several have been so great as to require particular mention.

To Mr. R. M. Garrison, Director of Elementary and Secondary Education of the Ohio State Department of Education and to his staff including Mr. L. L. Louthian, Mr. Glenn Rich, Mr. Walter Garland, and Mrs. Morna Larrick, special thanks are due for the assistance given in opening the records of the Department and for even more direct help.

The advice given by Dr. Philip Johnson and Dr. Edgar Martin of the United States Office of Education was invaluable. Without the expert counsel of these two men, both versed in obtaining information by the use of mass media, the preparation and circulation of the questionnaires which were used would have been much more difficult and less profitable.

It is impossible to forget the understanding and kindness of Dr. Laura Zirbes, who did so much toward keeping the study value-centered and who was always ready to help even though it meant sacrificing time which she needed badly for other work. The advice given by Dr. Earl Anderson during the earlier stages of the investigation is gratefully remembered. To Dr. Harold B. Alberty there

is extended a special feeling of gratitude for his careful analysis of the problem and for his assistance in strengthening the final report. He gave much help and gave it when it was most needed.

Without the assistance and guidance of Dr. G. P. Cahoon, this study would not have been possible. The entire point of view of the report has been affected by the years spent with him. He has seen more clearly than have most people the need for teachers who are competent and effective. This inquiry into teacher effectiveness has been an outgrowth of my association with him.

Finally, to my wife, who has aided and assisted at every step of the way, there is presented a heartfelt "thank you."

W. M. D.

TABLE OF CONTENTS

CHAPTER		PAGE
I	INTRODUCTION	1
II	METHODS, TECHNIQUES, AND PROCEDURES EMPLOYED	11
III	RELATED STUDIES AND A REVIEW OF THE LITERATURE	21
IV	FACTORS RELATED TO THE EFFECTIVENESS OF A LEARNING SITUATION IN SECONDARY SCIENCE.	89
V	THE TRAINING AND EXPERIENCE OF SCIENCE TEACHERS IN OHIO'S PUBLIC SECONDARY SCHOOLS.	171
VI	PHYSICAL CONDITIONS UNDER WHICH THE SCIENCES WERE TAUGHT IN OHIO'S SCHOOLS	258
VII	AREAS OF TEACHING AND TEACHING LOAD OF THE SCIENCE TEACHERS IN OHIO'S PUBLIC SECONDARY SCHOOLS	
VIII	PERSONAL AND PROFESSIONAL QUALITIES OF OHIO'S SCIENCE TEACHERS	454
IX	TEACHING METHODS USED BY OHIO'S SCIENCE TEACHERS--THEIR EQUIPMENT AND SUPPLIES FOR THE TEACHING OF SCIENCE.	517
X	EFFECTIVENESS OF A SAMPLING OF OHIO'S SCIENCE TEACHERS AS JUDGED BY PERSONAL INVESTIGATION	577
XI	INTERPRETATION OF THE FACTORS OF EFFECTIVENESS AS APPLIED TO SECONDARY- SCHOOL SCIENCE TEACHING.	600
XII	CONCLUSIONS AND RECOMMENDATIONS	678
	APPENDIX.	689
	BIBLIOGRAPHY	700
	AUTOBIOGRAPHY	719

LIST OF TABLES

TABLE		PAGE
I	NUMBER OF QUESTIONNAIRES SUBMITTED	97
II	RESPONSE TO FACTOR I.	99
III	RESPONSE TO FACTOR II	103
IV	RESPONSE TO FACTOR III.	105
V	RESPONSE TO FACTOR IV	110
VI	RESPONSE TO FACTOR V.	115
VII	RESPONSE TO FACTOR VI	119
VIII	RESPONSE TO FACTOR VII.	122
IX	RESPONSE TO FACTOR VIII	125
X	RESPONSE TO FACTOR IX.	128
XI	RESPONSE TO FACTOR X.	131
XII	RESPONSE TO FACTOR XI	134
XIII	RESPONSE TO FACTOR XII.	139
XIV	RESPONSE TO FACTOR XIII	142
XV	RESPONSE TO FACTOR XIV	146
XVI	RESPONSE TO FACTOR XV.	151
XVII	RESPONSE TO FACTOR XVI.	154
XVIII	RESPONSE TO FACTOR XVII	157
XIX	NUMBER, SEX, AND DISTRIBUTION OF OHIO'S SECONDARY TEACHERS	173

LIST OF TABLES (continued)

TABLE		PAGE
XX	DEGREES OFFERED BY TEACHERS IN OHIO'S COUNTY SCHOOLS	175
XXI	DEGREES OFFERED BY TEACHERS IN EXEMPTED VILLAGE SCHOOLS.	176
XXII	DEGREES OFFERED BY TEACHERS IN OHIO'S CITY SCHOOLS	177
XXIII	DATE OF MOST RECENT DEGREE OFFERED BY TEACHERS OF OHIO'S COUNTY SCHOOLS.	179
XXIV	PERCENT OF TEACHERS IN OHIO'S COUNTIES WHO TAUGHT ONE OR MORE CLASSES OF SCIENCE WHO OFFERED THEIR HIGHEST DEGREE IN CERTAIN YEAR	180
XXV	DATE OF MOST RECENT DEGREE OFFERED BY TEACHERS OF OHIO'S EXEMPTED VILLAGE SCHOOLS	181
XXVI	PERCENT OF TEACHERS IN OHIO'S EX- EMPTED VILLAGE SCHOOLS, OFFERING THEIR HIGHEST DEGREE IN CERTAIN YEARS	182
XXVII	DATE OF MOST RECENT DEGREE OFFERED BY TEACHERS OF OHIO'S CITY SCHOOLS	183
XXVIII	PERCENT OF TEACHERS IN OHIO'S CITY PUBLIC SCHOOLS WHO TAUGHT ONE OR MORE CLASSES OF SCIENCE OFFERING THEIR HIGHEST DEGREE IN CERTAIN YEARS	184
XXIX	NUMBER OF YEARS OF TEACHING EXPERIENCE OF TEACHERS IN OHIO'S COUNTY SCHOOLS.	189
XXX	PERCENTS OF MEN AND OF WOMEN TEACHERS IN OHIO'S COUNTY SCHOOLS HAVING TAUGHT VARIOUS NUMBER OF YEARS	190
XXXI	NUMBER OF YEARS OF TEACHING EXPERIENCE OF TEACHERS IN OHIO'S EXEMPTED VILLAGE SCHOOLS	191

LIST OF TABLES (continued)

TABLE		PAGE
XLI	PERCENT OF MEN AND OF WOMEN SCIENCE TEACHERS IN THE VARIOUS TYPES OF SECONDARY SCHOOLS OF OHIO WHO HAD OBTAINED AT LEAST A MASTER'S DEGREE . . .	202
XLII	RECENCY OF TRAINING OF MEDIAN SCIENCE TEACHERS IN THE VARIOUS CLASSES OF OHIO'S SECONDARY SCHOOLS AS JUDGED BY DATE OF MOST RECENT DEGREE	204
XLIII	RANKING OF VARIOUS GROUPS OF OHIO'S SECONDARY SCIENCE TEACHERS ACCORD- ING TO THE PERCENTAGE OF TEACHERS AMONG THEM WHO HAD NO DEGREE AWARDED SINCE 1920	205
XLIV	NUMBER OF YEARS TAUGHT BY MEDIAN TEACHERS OF SCIENCE IN THE THREE TYPES OF OHIO SECONDARY SCHOOLS	207
XLV	TOTAL NUMBER OF SEMESTER HOURS OF CREDIT IN ALL TYPES OF SCIENTIFIC SUBJECTS OFFERED BY OHIO'S COUNTY HIGH SCHOOL TEACHERS WHO TAUGHT AT LEAST ONE CLASS OF SCIENCE	209
XLVI	NUMBER OF SEMESTER HOURS OF SCIENCE LISTED BY 1470 COUNTY TEACHERS OF OHIO IN THE MAJOR AREA OF SCIENCE TEACHING	211
XLVII	SEMESTER HOURS OF CREDIT IN BIO- LOGICAL SCIENCES OFFERED BY OHIO'S COUNTY HIGH SCHOOL TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS BIOLOGY.	213
XLVIII	SEMESTER HOURS OF CHEMISTRY OFFERED BY OHIO'S COUNTY HIGH SCHOOL TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS CHEMISTRY	214

LIST OF TABLES (continued)

TABLE		PAGE
XLVIX	SEMESTER HOURS OF PHYSICS OFFERED BY OHIO'S COUNTY HIGH SCHOOL TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS PHYSICS	215
L	SEMESTER HOURS OF PROFESSIONAL EDUCATION OFFERED BY OHIO'S COUNTY HIGH SCHOOL TEACHERS WHO TAUGHT ONE OR MORE CLASSES OF SCIENCE	217
LI	SEMESTER HOURS OF CREDIT IN ALL TYPES OF SCIENTIFIC SUBJECTS OFFERED BY OHIO'S EXEMPTED VILLAGE TEACHERS WHO TAUGHT AT LEAST ONE CLASS OF SCIENCE . .	218
LII	NUMBER OF SEMESTER HOURS OF SCIENCE LISTED BY 207 EXEMPTED VILLAGE TEACHERS OF OHIO IN THEIR MAJOR AREA OF SCIENCE TEACHING	219
LIII	SEMESTER HOURS OF BIOLOGICAL SCIENCES OFFERED BY EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN BIOLOGY	220
LIV	SEMESTER HOURS OF CHEMISTRY OFFERED BY OHIO'S EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS CHEMISTRY	221
LV	SEMESTER HOURS OF PHYSICS OFFERED BY OHIO'S EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS PHYSICS	221
LVI	SEMESTER HOURS OF PROFESSIONAL EDUCATION CREDIT OFFERED BY 207 EXEMPTED VILLAGE TEACHERS OF SCIENCE	222
LVII	SEMESTER HOURS IN ALL TYPES OF SCIENTIFIC SUBJECTS OFFERED BY 864 OHIO CITY SCIENCE TEACHERS IN THE PUBLIC SECONDARY SCHOOLS.	223

LIST OF TABLES (continued)

TABLE		PAGE
LVIII	SEMESTER HOURS OF SCIENCE LISTED BY 864 OHIO CITY TEACHERS OF SCIENCE IN THE AREA OF THEIR MAJOR SCIENCE TEACHING EFFORT	224
LIX	SEMESTER HOURS OF BIOLOGICAL SCIENCE OFFERED BY OHIO'S CITY TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN BIOLOGY	225
LX	SEMESTER HOURS OF CHEMISTRY OFFERED BY OHIO'S CITY HIGH SCHOOL TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN CHEMISTRY	226
LXI	SEMESTER HOURS OF PHYSICS OFFERED BY OHIO'S CITY HIGH SCHOOL TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN THE AREA OF PHYSICS	227
LXII	SEMESTER HOURS OF PROFESSIONAL EDUCATION OFFERED BY 864 CITY HIGH SCHOOL TEACHERS OF SCIENCE IN OHIO.	228
LXIII	TOTAL NUMBER SEMESTER HOURS OF CREDIT IN ALL TYPES OF SCIENTIFIC SUBJECTS OFFERED BY 2541 TEACHERS IN OHIO'S HIGH SCHOOLS WHO TAUGHT ONE OR MORE CLASSES IN SCIENCE	229
LXIV	SEMESTER HOURS OF SCIENCE CREDIT, LISTED BY 2541 OHIO TEACHERS OF SECONDARY SCIENCE IN THE MAJOR AREA OF THEIR SCIENCE TEACHING EFFORT	230
LXV	SEMESTER HOURS OF BIOLOGICAL SCIENCES OFFERED BY 693 OHIO HIGH SCHOOL TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN BIOLOGY	231

LIST OF TABLES (continued)

TABLE		PAGE
LXVI	SEMESTER HOURS IN CHEMISTRY OFFERED BY 264 OHIO HIGH SCHOOL TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN CHEMISTRY	232
LXVII	SEMESTER HOURS OF PHYSICS OFFERED BY 312 OHIO HIGH SCHOOL TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN PHYSICS	233
LXVIII	SEMESTER HOURS OF PROFESSIONAL EDUCATION CREDITS OFFERED BY 2541 HIGH SCHOOL TEACHERS OF OHIO WHO TAUGHT ONE OR MORE CLASSES OF SCIENCE	234
LXIX	NUMBER OF HIGH SCHOOL TEACHERS TEACHING ONE OR MORE CLASSES OF SCIENCE WHO PRESENTED COLLEGE TRAINING IN ONLY ONE SUBJECT MATTER BRANCH OF SCIENCE.	236
LXX	SEMESTER HOURS OF ALL TYPES OF SCIENCE OFFERED BY 802 OHIO COUNTY HIGH SCHOOL TEACHERS, EACH OF WHOM TAUGHT AT LEAST ONE CLASS OF GENERAL SCIENCE	238
LXXI	SEMESTER HOURS OF UNDIFFERENTIATED SCIENCE OFFERED BY TEACHERS OF GENERAL SCIENCE IN OHIO'S COUNTY HIGH SCHOOLS.	239
LXXII	SEMESTER HOURS OF BIOLOGICAL SCIENCE OFFERED BY THE COUNTY TEACHERS OF GENERAL SCIENCE LISTED IN TABLE LIII. . .	240
LXXIII	SEMESTER HOURS OF PHYSICAL SCIENCE OFFERED BY THE COUNTY TEACHERS OF GENERAL SCIENCE LISTED IN TABLE LIII. . .	242

LIST OF TABLES (continued)

TABLE		PAGE
LXXIV	SEMESTER HOURS OF EARTH SCIENCE OFFERED BY THE COUNTY TEACHERS OF GENERAL SCIENCE LISTED IN TABLE LIII	243
LXXV	SEMESTER HOURS OF COLLEGE GENERAL SCIENCE OFFERED BY THE COUNTY TEACHERS OF GENERAL SCIENCE LISTED IN TABLE LIII	243
LXXVI	TOTAL NUMBER OF SEMESTER HOURS OF CREDIT IN ALL SCIENCES OFFERED BY COUNTY TEACHERS OF OHIO WHO TAUGHT ONE OR MORE CLASSES OF HIGH SCHOOL BIOLOGY	245
LXXVII	NUMBER OF SEMESTER HOURS OF BIO- LOGICAL SCIENCE OFFERED BY THE COUNTY TEACHERS OF BIOLOGY LISTED IN TABLE LIX	246
LXXVIII	NUMBER OF SEMESTER HOURS OF UN- DIFFERENTIATED SCIENCE OFFERED BY THE COUNTY TEACHERS OF BIOLOGY LISTED IN TABLE LIX.	247
LXXIX	TOTAL NUMBER OF SEMESTER HOURS OF CREDIT IN ALL SCIENCES OFFERED BY COUNTY TEACHERS OF OHIO WHO TAUGHT ONE OR MORE CLASSES OF HIGH SCHOOL CHEMISTRY	248
LXXX	SEMESTER HOURS OF CHEMISTRY OFFERED BY THE COUNTY HIGH SCHOOL TEACHERS OF CHEMISTRY LISTED IN TABLE LXII.	249
LXXXI	SEMESTER HOURS OF UNDIFFERENTIATED SCIENCE OFFERED BY OHIO COUNTY CHEMISTRY TEACHERS LISTED IN TABLE LXII	250
LXXXII	TOTAL NUMBER OF SEMESTER HOURS OF CREDIT IN ALL SCIENCES OFFERED BY COUNTY TEACHERS OF OHIO WHO TAUGHT ONE OR MORE CLASSES OF PHYSICS	251

LIST OF TABLES (continued)

TABLE		PAGE
LXXXIII	SEMESTER HOURS OF PHYSICS OFFERED BY THE COUNTY HIGH SCHOOL TEACHERS OF PHYSICS LISTED IN TABLE LXV	252
LXXXIV	SEMESTER HOURS OF UNDIFFERENTIATED SCIENCE OFFERED BY OHIO COUNTY PHYSICS TEACHERS LISTED IN TABLE LXV	253
LXXXV	CONDITION OF LABORATORIES, APPA- RATUS, EQUIPMENT, AND SCIENCE CLASS- ROOMS IN OHIO'S COUNTY SCHOOLS AS REPORTED BY THE HIGH SCHOOL SUPER- VISORS, 1948-1950	260
LXXXVI	CONDITION OF LABORATORIES, APPA- RATUS, EQUIPMENT AND SCIENCE CLASS- ROOMS IN OHIO'S EXEMPTED VILLAGE SCHOOLS AS REPORTED BY THE HIGH SCHOOL SUPERVISORS 1948-1950	260
LXXXVII	CONDITION OF LABORATORIES, APPA- RATUS, EQUIPMENT, AND SCIENCE CLASS- ROOMS IN OHIO'S CITY HIGH SCHOOLS AS REPORTED BY THE OHIO HIGH SCHOOL SUPERVISORS, 1948-1950	261
LXXXVIII	NUMBER OF LABORATORIES AND SCIENCE ROOMS IN OHIO'S COUNTY SCHOOLS EQUIPPED WITH CERTAIN TYPES OF FURNISHINGS, EQUIPMENT AND APPA- RATUS, AND NUMBER NOT SO EQUIPPED.	264
LXXXIX	NUMBER OF LABORATORIES AND SCIENCE ROOMS IN OHIO'S EXEMPTED VILLAGE SCHOOLS EQUIPPED WITH CERTAIN TYPES OF FURNISHINGS, EQUIPMENT, AND APPARATUS, AND NUMBER NOT SO EQUIPPED.	265
XC	NUMBER OF LABORATORIES AND SCIENCE ROOMS IN OHIO'S CITY SCHOOLS EQUIPPED WITH CERTAIN TYPES OF FURNISHINGS, EQUIPMENT AND APPARATUS, AND NUMBER NOT SO EQUIPPED	266

LIST OF TABLES (continued)

TABLE		PAGE
XC I	NUMBER AND PERCENT OF PRINCIPALS OR EXECUTIVE HEADS OF OHIO'S PUBLIC SECONDARY SCHOOLS WHO WERE TEACHING ONE OR MORE CLASSES OF SCIENCE, 1950-1951	274
XC II	NUMBER AND PERCENT OF COUNTY SCHOOLS HAVING ONLY ONE INDIVIDUAL TEACHING SECONDARY SCHOOL SCIENCE.	276
XC III	NUMBER OF SCIENCE TEACHERS IN OHIO'S COUNTY HIGH SCHOOLS (ENROLLMENTS 1- 25 PUPILS PER GRADE) WHO TAUGHT CERTAIN SCIENCE COMBINATIONS AND CERTAIN OTHER SUBJECTS OR AREA.	278
XC IV	ADDITIONAL SUBJECTS TAUGHT BY THE 173 TEACHERS IN THE SMALLEST OHIO COUNTY HIGH SCHOOLS WHO ARE LISTED IN TABLE XC III	279
XC V	TEACHERS IN OHIO'S SMALLEST COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING	281
XC VI	TEACHERS IN OHIO'S SMALLEST COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING	282
XC VII	TEACHERS IN OHIO'S SMALLEST COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING	283
XC VIII	TEACHERS IN OHIO'S SMALLEST COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING	284

LIST OF TABLES (continued)

TABLE		PAGE
XCIX	NUMBER OF TEACHERS IN OHIO'S SMALLEST COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS MATHEMATICS AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING	286
C	NUMBER OF TEACHERS IN THE SMALLEST DIVISION OF COUNTY SCHOOLS OF OHIO WHOSE MAJOR TEACHING AREA WAS SOCIAL STUDIES AND WHO HAD CERTAIN MINOR AREAS OF TEACHING WHICH IN- CLUDED SECONDARY SCIENCE SUBJECTS	287
CI	NUMBER OF TEACHERS IN THE SMALLEST OHIO HIGH SCHOOLS WHOSE MAJOR TEACHING WAS HOME ECONOMICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING WHICH INCLUDED SECONDARY SCIENCE SUBJECTS	288
CII	NUMBER OF TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO WHOSE MAJOR AREA OF TEACHING WAS AGRICULTURE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING WHICH INCLUDED SECONDARY SCIENCE SUBJECTS	289
CIII	NUMBER OF TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO WHOSE MAJOR AREA OF TEACHING WAS ENGLISH AND WHO HAD CERTAIN MINOR AREAS OF TEACHING WHICH INCLUDED SECONDARY SCIENCE SUBJECTS	289
CIV	NUMBER OF TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO WHOSE MAJOR AREA OF TEACHING WAS HEALTH OR PHYSICAL EDUCATION AND WHO HAD CERTAIN MINOR AREAS OF TEACHING WHICH INCLUDED SECONDARY SCIENCE SUBJECTS	290

LIST OF TABLES (continued)

TABLE		PAGE
CV	NUMBER OF TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO WHOSE MAJOR AREA OF TEACHING WAS COMMERCIAL AND WHO HAD CERTAIN MINOR AREAS OF TEACHING WHICH INCLUDED SECONDARY SCIENCE SUBJECTS	291
CVI	NUMBER OF TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO WHOSE MAJOR AREA OF TEACHING WAS INDUSTRIAL ARTS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING WHICH INCLUDED SECONDARY SCIENCE SUBJECTS	292
CVII	NUMBER OF TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO WHOSE MAJOR AREA OF TEACHING WAS ART AND WHO HAD CERTAIN MINOR AREAS OF TEACHING INCLUDING SECONDARY SCIENCE SUBJECTS . . .	292
CVIII	DISTRIBUTION OF SCIENCE TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO, WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR PORTION OF THEIR TEACHING TIME	293
CIX	NUMBER OF SEPARATE PREPARATIONS PER DAY OF 587 SCIENCE TEACHERS IN THE SMALLEST CATEGORY OF COUNTY SCHOOLS OF OHIO	295
CX	NUMBER OF CLASSES TAUGHT BY SECONDARY TEACHERS OF SCIENCE IN THE SMALLEST HIGH SCHOOLS OF OHIO'S COUNTIES.	297
CXI	NUMBER OF SCIENCE TEACHERS IN THE MEDIUM-SIZED COUNTY SCHOOLS OF OHIO WHO TAUGHT CERTAIN SCIENCE COMBINATIONS AND CERTAIN OTHER SUBJECTS OR AREAS	299
CXII	ADDITIONAL SUBJECTS OR AREAS TAUGHT BY THE 211 TEACHERS LISTED IN TABLE CXI	300

LIST OF TABLES (continued)

TABLE		PAGE
CXIII	NUMBER OF TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING	301
CXIV	NUMBER OF TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING	302
CXV	NUMBER OF TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING	303
CXVI	TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING	304
CXVII	TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS MATHEMATICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SCIENCE	305
CXVIII	TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREAS OF TEACHING WAS SOCIAL STUDIES AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SECONDARY SCIENCE.	306
CXIX	TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS HOME ECONOMICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SECONDARY SCIENCE.	307

LIST OF TABLES (continued)

TABLE		PAGE
CXX	TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS AGRICULTURE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SECONDARY SCIENCE	308
CXXI	TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS ENGLISH AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SECONDARY SCIENCE.	308
CXXII	TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS FOREIGN LANGUAGE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SECONDARY SCIENCE	309
CXXIII	TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS HEALTH OR PHYSICAL EDUCATION AND WHO HAD MINOR AREAS OF TEACHING IN SECONDARY SCIENCE	310
CXXIV	TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS INDUSTRIAL ARTS AND WHO HAD MINOR AREAS OF TEACHING IN SECONDARY SCIENCE	311
CXXV	TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS COMMERCIAL AND WHO HAD MINOR AREAS OF TEACHING IN SECONDARY SCIENCE	311

LIST OF TABLES (continued)

TABLE		PAGE
CXXVI	TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS MUSIC AND WHO HAD MINOR AREAS OF TEACHING	312
CXXVII	DISTRIBUTION OF SCIENCE TEACHERS IN THE MEDIUM-SIZED COUNTY SCHOOLS OF OHIO, WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR PORTION OF THEIR TEACHING TIME	313
CXXVIII	NUMBER OF SEPARATE PREPARATIONS PER DAY BY 600 SCIENCE TEACHERS IN THE MEDIUM-SIZED COUNTY SECOND-ARY SCHOOLS OF OHIO	315
CXXIX	NUMBER OF DIFFERENT CLASSES TAUGHT PER DAY BY 600 SCIENCE TEACHERS IN THE MEDIUM-SIZED COUNTY SCHOOLS OF OHIO	316
CXXX	NUMBER OF SCIENCE TEACHERS IN THE LARGER COUNTY HIGH SCHOOLS OF OHIO WHO TAUGHT CERTAIN SCIENCE COMBINATIONS ALONG WITH CERTAIN OTHER SUBJECTS OR AREAS	318
CXXXI	ADDITIONAL SUBJECTS OR AREAS TAUGHT BY THE 67 TEACHERS LISTED IN TABLE CXXX	319
CXXXII	NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING	320
CXXXIII	NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS CHEM-ISTRY AND WHO HAD CERTAIN OTHER AREAS OF TEACHING	321

LIST OF TABLES (continued)

TABLE		PAGE
CXXXIV	NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING	322
CXXXV	NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING	323
CXXXVI	NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS MATHEMATICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SCIENCE.	324
CXXXVII	NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS SOCIAL STUDIES AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SCIENCE	325
CXXXVIII	NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS HOME ECONOMICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SCIENCE	326
CXXXIX	NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS ENGLISH AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SCIENCE	327
CXL	NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS FOREIGN LANG- UAGE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SCIENCE	327

LIST OF TABLES (continued)

TABLE		PAGE
CXLI	NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS INDUSTRIAL ARTS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SCIENCE	328
CXLII	DISTRIBUTION OF SCIENCE TEACHERS IN THE LARGER COUNTY HIGH SCHOOLS OF OHIO, WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR PORTION OF THEIR TEACHING TIME	328
CXLIII	NUMBER OF SEPARATE PREPARATIONS PER DAY BY 287 SCIENCE TEACHERS IN THE LARGER SECONDARY SCHOOLS OF OHIO'S COUNTIES	330
CXLIV	NUMBER OF DIFFERENT CLASSES TAUGHT PER DAY BY 287 SCIENCE TEACHERS IN THE LARGER SECONDARY SCHOOLS OF OHIO'S COUNTIES	330
CXLV	NUMBER OF SCIENCE TEACHERS IN THE COUNTY HIGH SCHOOLS OF OHIO WHO WERE TEACHING VARIOUS COMBINATIONS OF SECONDARY SCIENCES	331
CXLVI	NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	332
CXLVII	NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	332
CXLVIII	NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	334

LIST OF TABLES (continued)

TABLE		PAGE
CXLIX	NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	335
CL	NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS MATHEMATICS AND WHO HAD MINOR AREAS IN SCIENCE TEACHING	336
CLI	NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS SOCIAL STUDIES AND WHO HAD MINOR AREAS IN SCIENCE TEACHING	337
CLII	NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS HOME ECONOMICS AND WHO HAD MINOR AREAS IN SCIENCE TEACHING	338
CLIII	NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS AGRICULTURE AND WHO HAD MINOR AREAS IN SCIENCE TEACHING	338
CLIV	NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS ENGLISH AND WHO HAD MINOR AREAS IN SCIENCE TEACHING	339
CLV	NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS FOREIGN LANGUAGE AND WHO HAD MINOR AREAS IN SCIENCE TEACHING	340
CLVI	NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS PHYSICAL EDUCATION OR HEALTH AND WHO HAD MINOR AREAS IN SCIENCE TEACHING	340

LIST OF TABLES (continued)

TABLE		PAGE
CLVII	NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS COMMERCIAL AND WHO HAD MINOR AREAS IN SCIENCE TEACHING	341
CLVIII	NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS INDUSTRIAL ARTS AND WHO HAD MINOR AREAS IN SCIENCE TEACHING	342
CLIX	NUMBER OF TIMES THE FOUR MAJOR SCIENCES WERE MENTIONED IN THE TEACHING AREAS OF THOSE TEACHING SCIENCE A MAJOR PORTION OF THEIR TIME AND THOSE TEACHING IT A MINOR PORTION OF THEIR TIME IN OHIO'S COUNTY HIGH SCHOOLS	343
CLX	NUMBER OF PREPARATIONS REQUIRED OF 1474 SCIENCE TEACHERS IN OHIO'S COUNTY HIGH SCHOOLS	344
CLXI	NUMBER OF CLASSES TAUGHT PER DAY BY 1474 OF OHIO'S HIGH SCHOOL TEACHERS IN THE COUNTY SYSTEMS WHO TAUGHT ONE OR MORE CLASSES OF SCIENCE	345
CLXII	EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS PHYSICS, AND WHO HAD CERTAIN OTHER MINOR TEACHING AREAS	347
CLXIII	EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY, AND WHO HAD CERTAIN OTHER MINOR TEACHING AREAS	348
CLXIV	EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN MINOR TEACHING AREAS	348

LIST OF TABLES (continued)

TABLE		PAGE
CLXV	EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN MINOR TEACHING AREAS	350
CLXVI	EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS SENIOR OR PHYSICAL SCIENCE AND WHO HAD CERTAIN MINOR TEACHING AREAS.	351
CLXVII	EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS MATHE- MATICS AND WHO HAD CERTAIN MINOR AREAS OF SCIENCE TEACHING	352
CLXVIII	EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS SOCIAL STUDIES AND WHO HAD CERTAIN MINOR AREAS OF SCIENCE	353
CLXIX	EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS HOME ECONOMICS AND WHO HAD CERTAIN MINOR AREAS OF SCIENCE TEACHING	353
CLXX	EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS ENGLISH AND WHO HAD CERTAIN MINOR AREAS OF SCIENCE TEACHING	354
CLXXI	EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS FOREIGN LANGUAGE AND WHO HAD CERTAIN MINOR AREAS OF SCIENCE TEACHING	354
CLXXII	EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS HEALTH OR PHYSICAL EDUCATION AND WHO HAD CERTAIN MINOR AREAS OF SCIENCE TEACHING	354

LIST OF TABLES (continued)

TABLE		PAGE
CLXXIII	EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS INDUSTRIAL ARTS AND WHO HAD CERTAIN MINOR AREAS OF SCIENCE TEACHING	355
CLXXIV	NUMBER OF PREPARATIONS PER DAY REQUIRED OF SCIENCE TEACHERS IN THE EXEMPTED VILLAGE SCHOOLS OF OHIO	356
CLXXV	NUMBER OF CLASSES TAUGHT PER DAY BY 207 EXEMPTED VILLAGE SCIENCE TEACHERS IN OHIO	357
CLXXVI	DISTRIBUTION OF SCIENCE TEACHERS IN THE EXEMPTED VILLAGE SCHOOLS OF OHIO WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR PORTION OF THEIR TEACHING TIME	358
CLXXVII	NUMBER OF TIMES THE FOUR MAJOR SCIENCES WERE MENTIONED IN THE TEACHING AREAS OF THOSE TEACHING SCIENCE A MAJOR PORTION AND THOSE TEACHING IT A MINOR PORTION OF THEIR TIME IN OHIO'S EXEMPTED VILLAGE SCHOOLS	359
CLXXVIII	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	362
CLXXIX	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	362

LIST OF TABLES (continued)

TABLE		PAGE
CLXXX	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	363
CLXXXI	TEACHERS IN OHIO'S CITY SCHOOLS (1-100 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING.	364
CLXXXII	TEACHERS IN OHIO'S CITY SCHOOLS (1-100 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS MATHEMATICS AND WHO HAD CERTAIN MINOR SCIENCE AREAS	365
CLXXXIII	TEACHERS IN OHIO'S CITY SCHOOLS (1-100 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS SOCIAL STUDIES AND WHO HAD CERTAIN MINOR SCIENCE AREAS	366
CLXXXIV	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS INDUSTRIAL ARTS AND WHO HAD CERTAIN MINOR SCIENCE AREAS	366
CLXXXV	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS PHYSICAL EDUCATION AND WHO HAD CERTAIN MINOR SCIENCE AREAS	366
CLXXXVI	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS MUSIC AND WHO HAD CERTAIN MINOR SCIENCE AREAS.	367

LIST OF TABLES (continued)

TABLE		PAGE
CLXXXVII	DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE) WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR EX- PENDITURE OF THEIR TEACHING TIME	368
CLXXXVIII	NUMBER OF PREPARATIONS REQUIRED DAILY OF 73 SCIENCE TEACHERS IN OHIO'S CITY SCHOOLS (1-100 PUPILS PER GRADE).	369
CLXXXIX	NUMBER OF DIFFERENT CLASSES TAUGHT PER DAY BY 73 SCIENCE TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE)	370
CXC	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	371
CXCI	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	372
CXCII	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	374

LIST OF TABLES (continued)

TABLE		PAGE
CXCIII	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACH- ING WAS GENERAL SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACH- ING	375
CXCIV	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS PHYSICAL OR SENIOR SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	376
CXCV	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS IN MATHEMATICS AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	377
CXCVI	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS SOCIAL STUDIES AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	378
CXCVII	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS IN ENGLISH AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	378
CXCVIII	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS FOREIGN LANGUAGE AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	378

LIST OF TABLES (continued)

TABLE		PAGE
CXCIX	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS INDUSTRIAL ARTS AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	379
CC	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS PHYSICAL EDUCATION AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	379
CCI	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS IN ART AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	379
CCII	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS SEVEN AND EIGHT SCIENCE AND WHO HAD CERTAIN MINOR AREAS.	382
CCIII	DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE) WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR EXPENDITURE OF THEIR TEACHING TIME.	381
CCIV	NUMBER OF PREPARATIONS REQUIRED DAILY OF 235 SCIENCE TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE	382
CCV	NUMBER OF DIFFERENT CLASSES TAUGHT PER DAY BY 235 SCIENCE TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE	383

LIST OF TABLES (continued)

TABLE		PAGE
CCVI	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD OTHER MINOR AREAS OF TEACHING	385
CCVII	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD OTHER MINOR AREAS OF TEACHING	385
CCVIII	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	386
CCIX	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	387
CCX	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS PHYSICAL OR SENIOR SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING	388
CCXI	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS PHYSIOLOGY, BOTANY OR ZOOLOGY AND WHO HAD CERTAIN MINOR AREAS	388

LIST OF TABLES (continued)

TABLE		PAGE
CCXII	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS MATHEMATICS AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	389
CCXIII	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS IN SOCIAL STUDIES AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	389
CCXIV	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS IN INDUSTRIAL ARTS OR VOCATIONAL AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	390
CCXV	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS HEALTH OR PHYSICAL EDUCATION AND WHO HAD MINOR AREAS IN SCIENCE	390
CCXVI	TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS IN HOME ECONOMICS AND WHO HAD MINOR AREAS IN SCIENCE . . .	390
CCXVII	DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201- 300 PUPILS PER GRADE) WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR EXPENDITURE OF THEIR TEACHING TIME	391

LIST OF TABLES (continued)

TABLE	PAGE
CCXVIII	DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S CITIES (201-300 PUPILS PER GRADE) WITH REGARD TO THE NUMBER OF PREPARATIONS REQUIRED PER DAY 392
CCXIX	DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201- 300 PUPILS PER GRADE) WITH REGARD TO THE NUMBER OF CLASSES TAUGHT PER DAY 393
CCXX	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING 395
CCXXI	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN CHEMISTRY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING 396
CCXXII	TEACHERS IN OHIO'S LARGEST HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN BIOLOGY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING 397
CCXXIII	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN GENERAL SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING. 398
CCXXIV	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSICAL OR SENIOR SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING 399

LIST OF TABLES (continued)

TABLE		PAGE
CCXXV	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSIOLOGY, BOTANY, OR ZOOLOGY AND WHO HAD CERTAIN AREAS OF TEACHING	399
CCXXVI	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSIOGRAPHY AND WHO HAD CERTAIN MINOR AREAS	400
CCXXVII	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN ELECTRICITY AND RADIO	401
CCXXVIII	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN MATHEMATICS AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	401
CCXXIX	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN SOCIAL STUDIES AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	402
CCXXX	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN ENGLISH AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE.	402
CCXXXI	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN INDUSTRIAL ARTS AND WHO HAD MINOR AREAS IN SCIENCE	403
CCXXXII	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSICAL EDUCATION OR HEALTH AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	403

LIST OF TABLES (continued)

TABLE		PAGE
CCXXIII	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN HOME ECONOMICS AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	404
CCXXXIV	TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN AGRI- CULTURE AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE	404
CCXXXV	DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR EXPENDITURE OF THEIR TEACHING TIME	405
CCXXXVI	DISTRIBUTION OF TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WITH REGARD TO THE NUMBER OF PREPARATIONS REQUIRED PER DAY	406
CCXXXVII	DISTRIBUTION OF TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WITH REGARD TO THE NUMBER OF CLASSES TAUGHT PER DAY	407
CCXXXVIII	MINOR AREAS OF OHIO'S CITY TEACHERS WHOSE MAJOR AREA WAS IN PHYSICS.	408
CCXXXIX	MINOR AREAS OF OHIO'S CITY TEACHERS WHOSE MAJOR AREA WAS IN CHEMISTRY.	409
CCXL	MINOR AREAS OF OHIO'S CITY TEACHERS WHOSE MAJOR AREA WAS IN BIOLOGY	410
CCXLI	MINOR AREAS OF OHIO'S CITY TEACHERS WHOSE MAJOR AREA WAS IN GENERAL SCIENCE	411
CCXLII	MINOR AREAS OF OHIO'S CITY TEACHERS WHOSE MAJOR AREAS WERE IN PHYSICAL OR SENIOR SCIENCE	412

LIST OF TABLES (continued)

TABLE		PAGE
CCXLIII	MINOR AREAS OF CITY TEACHERS WHOSE MAJOR AREAS WERE IN PHYSIOLOGY, BOTANY, OR ZOOLOGY	413
CCXLIV	MINOR AREAS OF AN OHIO TEACHER WHOSE MAJOR AREA WAS IN PHYSIOGRAPHY	413
CCXLV	MINOR AREAS OF OHIO'S CITY TEACHERS WHOSE MAJOR AREA WAS IN SEVENTH AND EIGHTH GRADE SCIENCE	414
CCXLVI	MINOR AREAS OF OHIO'S CITY TEACHERS WHOSE MAJOR AREAS WERE IN ELECTRICITY AND RADIO.	414
CCXLVII	SCIENCE AREAS OF OHIO'S CITY TEACHERS WHOSE MAJOR AREA OF TEACHING WAS IN MATHEMATICS	415
CCXLVIII	SCIENCE AREAS OF CITY TEACHERS WHOSE MAJOR AREA OF TEACHING WAS IN SOCIAL STUDIES	415
CCXLIX	SCIENCE AREAS OF CITY TEACHERS WHOSE MAJOR AREA OF TEACHING WAS IN ENGLISH	416
CCCL	SCIENCE AREAS OF CITY TEACHERS WHOSE MAJOR AREA OF TEACHING WAS IN FOREIGN LANGUAGE	417
CCCLI	SCIENCE AREAS OF CITY TEACHERS WHOSE MAJOR AREA OF TEACHING WAS IN THE INDUSTRIAL ARTS	417
CCCLII	SCIENCE AREAS OF CITY TEACHERS WHOSE MAJOR AREA OF TEACHING WAS PHYSICAL EDUCATION OR HEALTH.	417
CCCLIII	SCIENCE AREAS OF CITY TEACHERS WHOSE MAJOR AREA OF TEACHING WAS IN HOME ECONOMICS	418

LIST OF TABLES (continued)

TABLE		PAGE
CCLIV	SCIENCE AREAS OF CITY TEACHERS WHOSE MAJOR AREA OF TEACHING WAS IN AGRICULTURE	413
CCLV	SCIENCE AREAS OF CITY TEACHERS WHOSE MAJOR AREA OF TEACHING WAS IN MUSIC	413
CCLVI	SCIENCE AREAS OF CITY TEACHERS WHOSE MAJOR AREA OF TEACHING WAS IN ART	419
CCLVII	DISTRIBUTION OF CITY TEACHERS WITH RESPECT TO MAJOR AREA OF TEACHING	420
CCLVIII	NUMBER OF PREPARATIONS PER DAY REQUIRED OF CITY SCIENCE TEACHERS	421
CCLIX	NUMBER OF CLASSES TAUGHT PER DAY BY CITY SCIENCE TEACHERS	422
CCLX	OCCURRENCE OF THE MAJOR SCIENCES IN TEACHING LOADS	422
CCLXI	MINOR AREAS OF TEACHERS WHO HAD A MAJOR AREA IN PHYSICS.	424
CCLXII	MINOR AREAS OF TEACHERS WHO HAD A MAJOR AREA IN CHEMISTRY.	425
CCLXIII	MINOR AREAS OF TEACHERS WHO HAD A MAJOR AREA IN BIOLOGY.	426
CCLXIV	MINOR AREAS OF TEACHERS WHO HAD A MAJOR AREA IN GENERAL SCIENCE	427
CCLXV	MINOR AREAS OF TEACHERS WHO HAD A MAJOR AREA IN SENIOR SCIENCE	428

LIST OF TABLES (Continued)

TABLE		PAGE
CCLXVI	MINOR AREAS OF TEACHERS WHOSE MAJOR AREA OF TEACHING WAS IN SEVENTH AND EIGHTH GRADE SCIENCE	429
CCLXVII	MINOR SCIENCE AREAS OF TEACHERS WHOSE MAJOR AREA WAS IN MATHEMATICS.	430
CCLXVIII	MINOR SCIENCE AREAS OF TEACHERS WHOSE MAJOR AREA WAS IN SOCIAL STUDIES	431
CCLXIX	MINOR SCIENCE AREAS OF TEACHERS WHOSE MAJOR AREA WAS IN ENGLISH	432
CCLXX	MINOR SCIENCE AREAS OF TEACHERS WHOSE MAJOR AREA WAS IN FOREIGN LANGUAGES.	433
CCLXXI	MINOR SCIENCE AREAS OF TEACHERS WHOSE MAJOR AREA WAS IN INDUSTRIAL ARTS.	433
CCLXXII	MINOR SCIENCE AREAS OF TEACHERS WHOSE MAJOR AREA WAS IN HOME ECONOMICS	434
CCLXXIII	MINOR SCIENCE AREAS OF TEACHERS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSICAL EDUCATION AND HEALTH	435
CCLXXIV	MINOR SCIENCE AREAS OF TEACHERS WHOSE MAJOR AREA OF TEACHING WAS IN AGRI- CULTURE	435
CCLXXV	CURRICULAR OFFERINGS IN OHIO'S SMALLEST COUNTY HIGH SCHOOLS	437

LIST OF TABLES (continued)

TABLE		PAGE
CCLXXVI	SCIENCE OFFERINGS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS	439
CCLXXVII	CURRICULAR OFFERINGS IN OHIO'S LARGEST COUNTY HIGH SCHOOLS	440
CCLXXVIII	SCIENCE OFFERINGS IN OHIO'S EXEMPTED VILLAGE HIGH SCHOOLS	441
CCLXXIX	SCIENCE OFFERINGS IN OHIO'S SMALLEST CITY HIGH SCHOOLS	442
CCLXXX	SCIENCE OFFERINGS IN OHIO'S NEXT-TO-THE-SMALLEST CITY HIGH SCHOOLS	443
CCLXXXI	SCIENCE OFFERINGS IN OHIO'S NEXT-TO-THE-LARGEST CITY HIGH SCHOOLS.	444
CCLXXXII	SCIENCE OFFERINGS IN OHIO'S LARGEST CITY HIGH SCHOOLS	445
CCLXXXIII	SCIENCE SUBJECTS ASIDE FROM THE STANDARD FOUR OFFERED IN OHIO'S SCHOOLS	446
CCLXXXIV	PERCENT AND NUMBER OF QUESTIONNAIRES RETURNED	455
CCLXXXV	NUMBER OF COUNTY AND EXEMPTED VILLAGE TEACHERS CLAIMING VARIOUS AMOUNTS OF OUTSIDE EXPERIENCE	457
CCLXXXVI	TYPES OF VOCATIONS LISTED BY COUNTY AND EXEMPTED VILLAGE TEACHERS	459
CCLXXXVII	TOTAL AMOUNT OF TIME SPENT IN SCIENCE-RELATED OCCU- PATIONS BY COUNTY AND EXEMPTED VILLAGE TEACHERS	460

LIST OF TABLES (continued)

TABLE		PAGE
CCLXXXVIII	SCIENCE-RELATED HOBBIES REPORTED BY COUNTY AND EXEMPTED VILLAGE TEACHERS	461
CCLXXXIX	TYPES OF SCHOOLS ATTENDED BY OHIO'S COUNTY AND EXEMPTED VILLAGE TEACHERS	463
CCXC	MEMBERSHIP IN VARIOUS SCIENCE- RELATED ORGANIZATIONS REPORTED BY COUNTY AND VILLAGE TEACHERS.	465
CCXCI	SCIENCE-RELATED MAGAZINES REPORTED READ REGULARLY BY COUNTY AND EXEMPTED VILLAGE TEACHERS	467
CCXCII	SCIENCE-RELATED MAGAZINES REPORTED READ OCCASIONALLY BY COUNTY AND EXEMPTED VILLAGE TEACHERS	468
CCXCIII	SCIENCE-RELATED BOOKS REPORTED READ BY COUNTY AND EXEMPTED VILLAGE TEACHERS.	469
CCXCIV	ADDITIONAL FACTORS WHICH INFLUENCED TRAINING OF COUNTY AND EXEMPTED VILLAGE TEACHERS	470
CCXCV	POSITIONS OF LEADERSHIP RE- PORTED BY COUNTY AND EXEMPTED VILLAGE SCIENCE TEACHERS.	471
CCXCVI	LENGTH OF SERVICE AS CHURCH LEADER REPORTED BY COUNTY AND EXEMPTED VILLAGE SCIENCE TEACHERS	472
CCXCVII	SCIENCE TEACHERS REPORTING LEADERSHIP IN OUT-OF-SCHOOL YOUTH ORGANIZATIONS	473

LIST OF TABLES (continued)

TABLE		PAGE
CCXCVIII	TYPES OF YOUTH ACTIVITIES SPONSORED BY OHIO'S COUNTY AND EXEMPTED VILLAGE TEACHERS	473
CCXCIX	NUMBER AND PERCENT OF COUNTY AND EXEMPTED VILLAGE SCIENCE TEACHERS REPORTING MEMBERSHIP IN COMMUNITY ORGANIZATIONS	474
CCC	NUMBER AND TYPE OF AFFILIATIONS REPORTED BY COUNTY AND EXEMPTED VILLAGE SCIENCE TEACHERS	475
CCCI	AFFILIATIONS REPORTED BY COUNTY AND EXEMPTED VILLAGE SCIENCE TEACHERS.	476
CCCII	NUMBER AND PERCENT OF COUNTY AND EXEMPTED VILLAGE TEACHERS RESPONDING TO FUND DRIVES	476
CCCIII	TYPES OF DRIVE INDICATED BY COUNTY AND EXEMPTED VILLAGE TEACHERS	477
CCCIV	NON-TEACHING DUTIES OF COUNTY AND EXEMPTED VILLAGE TEACHERS INFLUENCE.	480
CCCV	BELIEFS OF TEACHERS CONCERNING EXTRA-CURRICULAR LOAD TEACHING.	481
CCCVI	BELIEFS OF SCIENCE TEACHERS CONCERNING INFLUENCE OF COMMUNITY DUTIES	482
CCCVII	NUMBER OF HOURS PER WEEK OUT- SIDE EMPLOYMENT UNDERTAKEN BY COUNTY AND EXEMPTED VILLAGE TEACHERS	483

LIST OF TABLES (continued)

TABLE		PAGE
CCCVIII	NUMBER OF PUPILS PER DAY REPORTED BY COUNTY AND EXEMPTED VILLAGE SCIENCE TEACHERS	484
CCCXIX	NUMBER OF PREPARATIONS PER DAY REPORTED BY COUNTY AND EXEMPTED VILLAGE SCIENCE TEACHERS	485
CCCX	NUMBER OF STUDY HALLS RE- PORTED PER DAY BY COUNTY AND EXEMPTED VILLAGE TEACHERS	485
CCCXI	NUMBER OF CITY TEACHERS CLAIMING OUT-OF-SCHOOL EXPERIENCES.	487
CCCXII	TYPES OF VOCATIONS LISTED BY OHIO ' S CITY SCIENCE TEACHERS.	487
CCCXIII	TOTAL TIME SPENT IN OUTSIDE VOCATIONS BY OHIO'S CITY SCIENCE TEACHERS	488
CCCXIV	SCIENCE-RELATED HOBBIES RE- PORTED BY CITY SCIENCE TEACHERS	489
CCCXV	TYPES OF SCHOOLS ATTENDED BY CITY SCIENCE TEACHERS	490
CCCXVI	MEMBERSHIP IN SCIENCE- RELATED ORGANIZATIONS CLAIMED BY CITY SCIENCE TEACHERS	491
CCCXVII	SCIENCE-RELATED MAGAZINES READ REGULARLY BY CITY SCIENCE TEACHERS.	493

LIST OF TABLES (continued)

TABLE		PAGE
CCCXVIII	SCIENCE-RELATED MAGAZINES READ OCCASIONALLY BY CITY SCIENCE TEACHERS	494
CCCXIX	SCIENCE-RELATED BOOKS READ BY CITY SCIENCE TEACHERS	495
CCCXX	ADDITIONAL TRAINING OF CITY SCIENCE TEACHERS	496
CCCXXI	CITY SCIENCE TEACHERS REPORTING CHURCH LEADERSHIP.	498
CCCXXII	LENGTH OF SERVICE AS A CHURCH LEADER REPORTED BY CITY SCIENCE TEACHERS	498
CCCXXIII	CITY TEACHERS REPORTING OUT- OF-SCHOOL YOUTH LEADERSHIP	499
CCCXXIV	TYPES OF YOUTH ACTIVITIES SPONSORED BY CITY SCIENCE TEACHERS	500
CCCXXV	FRATERNAL, SOCIAL, AND CIVIC MEMBERSHIPS REPORTED BY CITY SCIENCE TEACHERS	501
CCCXXVI	NUMBER AND TYPE OF FRATERNAL AFFILIATIONS REPORTED BY CITY SCIENCE TEACHERS	502
CCCXXVII	PARTICIPATION OF CITY TEACHERS IN COMMUNITY DRIVES.	503
CCCXXVIII	TYPES OF DRIVES CITY TEACHERS REPORTED	504
CCCXXIX	NON-TEACHING DUTIES OF CITY SCIENCE TEACHERS	507

LIST OF TABLES

TABLE		PAGE
CCCXXX	BELIEFS OF CITY SCIENCE TEACHERS CONCERNING EXTRA- CURRICULAR DUTIES	503
CCCXXXI	BELIEFS OF CITY SCIENCE TEACHERS CONCERNING COMMUNITY RESPONSIBILITIES	510
CCCXXXII	EXTRA-CONTRACTUAL WORK RE- PORTED BY CITY SCIENCE TEACHERS	511
CCCXXXIII	NUMBER OF PUPILS PER DAY REPORTED BY CITY SCIENCE TEACHERS	512
CCCXXXIV	NUMBER OF PREPARATIONS PER DAY REPORTED BY CITY SCIENCE TEACHERS	513
CCCXXXV	NUMBER OF STUDY HALLS PER DAY REPORTED BY CITY SCIENCE TEACHERS	513
CCCXXXVI	USE OF EDUCATIONAL MOVIES IN THE STATE'S SCHOOLS	522
CCCXXXVII	ABILITY TO OPERATE MOVIE PROJECTOR	523
CCCXXXVIII	ABILITY OF TEACHERS TO REPAIR MOVIE PROJECTORS	524
CCCXXXIX	USE OF FILM-STRIPS AND SLIDE- FILMS BY SCIENCE TEACHERS	525
CCCXL	ABILITY OF SCIENCE TEACHERS TO OPERATE FILM-STRIP PROJECTORS.	526
CCCXLI	ABILITY OF SCIENCE TEACHERS TO MAKE AND USE HOMEMADE SLIDES	528

LIST OF TABLES (continued)

TABLE		PAGE
CCCXLII	CONSTRUCTION AND USE OF HOME- MADE SLIDES	528
CCCXLIII	ABILITY OF TEACHERS TO USE RECORDING DEVICES	529
CCCXLIV	USE OF RECORDERS BY OHIO'S SCIENCE TEACHERS	530
CCCXLV	FREQUENCY OF USE OF MODELS, EXHIBITS, ETC. BY OHIO'S SCIENCE TEACHERS	531
CCCXLVI	FREQUENCY OF CONSTRUCTION OF MODELS, EXHIBITS, ETC. BY SCIENCE TEACHERS AND PUPILS	532
CCCXLVII	FREQUENCY OF CONSTRUCTION OF NEEDED APPARATUS	534
CCCXLVIII	COMPETENCY OF TEACHERS IN THEIR SCIENCE SITUATION	535
CCCXLIX	DEGREE OF USE OF THE FIELD TRIP	536
CCCL	USE OF LIBRARIES BY SCIENCE TEACHERS	539
CCCLI	USE OF PRINTED MATERIALS OTHER THAN THE TEXT	541
CCCLII	NUMBER OF TEXTBOOKS USED BY SCIENCE TEACHERS	542
CCCLIII	USE OF COMMUNITY RESOURCES BY SCIENCE TEACHERS	543
CCCLIV	KNOWLEDGE OF GOVERNMENTAL SOURCES OF MATERIALS	544

LIST OF TABLES (continued)

TABLE		PAGE
CCCLV	USE OF STATE-SPONSORED TEACHING MATERIALS	545
CCCLVI	KNOWLEDGE ABOUT PRINTED TESTS	546
CCCLVII	USE OF NON-TEACHER PRE- PARED TESTS	547
CCCLVIII	USE OF RESOURCE UNITS BY SCIENCE TEACHERS.	549
CCCLIX	FAMILIARITY OF TEACHERS WITH SOURCES OF FREE AND LOW-COST MATERIALS	550
CCCLX	USE OF FREE AND LOW-COST MATERIALS BY SCIENCE TEACHERS	551
CCCLXI	FAMILIARITY OF TEACHERS WITH THE WORK OF SCIENCE CLUBS OF AMERICA	552
CCCLXII	USE OF MATERIALS PREPARED BY SCIENCE CLUBS OF AMERICA	552
CCCLXIII	KNOWLEDGE OF THE WORK OF THE JUNIOR ACADEMY OF SCIENCE CLAIMED BY SCIENCE TEACHERS.	554
CCCLXIV	PARTICIPATION IN SCIENCE FAIRS BY OHIO STUDENTS	555
CCCLXV	USE OF GOVERNMENTAL PUBLICATIONS BY SCIENCE TEACHERS.	556
CCCLXVI	EXTENT TO WHICH TEACHERS FOLLOW THE TEXTBOOK	557
CCCLXVII	DEGREE TO WHICH TEACHERS USED STUDENTS IN PLANNING SCIENCE WORK	559

LIST OF TABLES (continued)

TABLE		PAGE
CCCLXVIII	CONDITION OF SCIENCE ROOMS AND LABORATORIES	560
CCCLXIX	CONDITION OF PHYSICAL FAC- ILITIES OF OHIO'S SCHOOLS.	561
CCCLXX	CONDITION OF LABORATORY FURNISHINGS IN OHIO'S SCHOOLS.	562
CCCLXXI	EQUIPMENT IN SCIENCE LAB- ORATORIES OF OHIO	564
CCCLXXII	EXPENDITURES OF OHIO'S SCHOOLS FOR LABORATORY EQUIPMENT	566
CCCLXXIII	CONDITION OF PAINT IN SCIENCE ROOMS OF OHIO	567
CCCLXXIV	ADEQUACY OF JANITORIAL SERVICE IN OHIO'S SCIENCE DEPARTMENTS.	568
CCCLXXVI	VENTILATION AND HEATING CON- DITIONS IN SCIENCE ROOMS	569
CCCLXXVII	SUITABILITY OF WINDOW SHADES FOR TEACHING SCIENCE	570
CCCLXXVIII	OBJECTIVES OF SCIENCE TEACHERS	571
CCCLXXIX	GENERAL EFFECTIVENESS AND FACTOR EFFECTIVENESS OF A SAMPLING OF SCIENCE TEACHERS	583
CCCLXXX	FACTOR EFFECTIVENESS OF "EXCEL- LENT" TEACHERS	585
CCCLXXXI	FACTOR EFFECTIVENESS OF "GOOD" TEACHERS	586
CCCLXXXII	FACTOR EFFECTIVENESS OF "FAIR" TEACHERS	587

LIST OF TABLES (continued)

TABLE		PAGE
CCCLXXXIII	FACTOR EFFECTIVENESS OF "POOR" TEACHERS	588

CHAPTER I

A STATEMENT OF THE PROBLEM

INTRODUCTION

It seems safe to assume that wherever individuals gather together, teaching and learning take place. Learning occurred and teaching was undertaken long before the advent of the formalized school. Just as certainly, much learning still occurs outside the confines of the school prior to, during, and after the ending of the individual's formal schooling period.

Schools as such have changed greatly since the first attempts were made at imparting information to groups of young people as opposed to the simpler and earlier process of parental instruction. Since the establishment of our nation, reforms so radical as to be called revolutionary have swept through the philosophy no less than through the practice of education. Beginning with the idea of formalized education as a privilege of the elite, we have come, as a nation, through the concepts of common schooling for all, of secondary schooling for all, and seem on the brink of accepting a philosophy which looks toward schooling beyond secondary level for all of the children of all of the people.

Common schooling has long been recognized as the right of every child in our nation, although there are great numbers of our children, particularly in the poorer areas, who are unable to profit by exercise

of that right.

It was not until the Kalamazoo case,¹ however, that the place of the high school in the American scene was established by legal decision, and it was not established in the thinking of the general citizenry until much later. It was many years before this way of thinking led to the downfall of the academy with its tradition of education for those who could afford it and to the general establishment of the public high school, accepted on the same basis as the elementary or common school.

It is on this basis that the secondary school has entered the American scene. It developed from the academy and from the earlier Latin grammar type of school. As it expanded its population in the greatest mass secondary movement of all time, it has had to change its program and even its basic philosophy many times. Beginning as a college preparatory school, competing for its life and for academic respectability with the entrenched academies, the first high schools presented a formal and narrow program. Though sometimes called poor men's universities, they were quite stuffy in their traditionalism. Their teachers were "professors" and their appeal was limited.

As the high school became surer of its position, and as the great mass of students made their presence felt, the tendency was

¹ Encyclopedia of Modern Education, Hubner and Company, New York, 1943, p. 436.

in the direction of a broadened purpose and of broadened thinking in the secondary school program. Today the American high school stands unique as an experiment in public education. The program has been broadened to such an extent that it sometimes is difficult to find the hard core of subject areas upon which the first high schools were erected. The sciences and social sciences were among the first to breach the academic wall of respectability, to be followed by the many other offerings which now are included in the course of study of the usual American high school. Extra-curricular ventures of yesterday have come to be regarded as the curricular offerings of today. Sheer necessity has added to the breadth of the high school program.

As the high school evolved, there was no over-all pattern of development, planned on a nation-wide or even usually, on a state-wide basis. There have been certain state-wide courses of study developed, but by and large, the high school has, amoeba-like, felt its way into new regions, and moved into them when the necessity appeared and when the resistance was not too great. It may be said safely that the development of the American high school has been a confused development, with cross-currents the rule, and with muddled thinking and expediency too often setting the pace. There has been no clearly defined plan for American secondary education aside from the pattern set by accrediting agencies and the entrance requirements of colleges.

The only central theme apparent which embraces the total picture has been the idea that "education" should be made available to all who desired it and could profit from it.

As with the development of the schools, so with teaching, there appears to have been, through the years, no clearly conceived scheme, no central direction. Teachers in the same school too often teach at cross purposes, or with no purpose at all apparent save the idea of "putting in the day." Psychologies and philosophies have come and gone, leaving confusion in their wake. Some of these confusions have dealt with end, some with method. Clearly the type of philosophy to which we adhere should direct us to the ends of teaching which are in line with that philosophy. Just as clearly, we have not arrived at the stage when all of our educators have achieved uniformity in philosophy. Thus among adherents of the various philosophies we may expect to be faced with disputes concerning the ultimate ends of teaching. Perhaps more serious is the fact that many teachers appear to be teaching in directions which admit of no philosophic interpretation at all or which are undertaken with no philosophic considerations whatsoever.

Granted that there are confusions in philosophy and that the ends of teaching may be different among teachers, there are yet many considerations with regard to the way in which teaching is done which may have sufficient importance to warrant further study.

Granted that two teachers may have vastly different ends in view in teaching about Archimedes principle, there still may be means of presenting the principle in such fashion that learning takes place more readily and that functional learning does, in fact, take place. Tests and measurements, imperfect though they are, have advanced as allied sciences to the point at which it is possible to measure degrees of learning and even functionality of learning to a much greater extent than previously was believed possible.

Although we may not be able to agree on the desirability of a given objective in our teaching, we can, at least with a good degree of accuracy, measure the outcomes of learning in certain directions. Thus we may conclude that if we first state our objectives we may have effective or ineffective teaching insofar as those objectives are concerned. If we have effective teaching, then there must be factors which make the teaching effective or ineffective, or which at least tend to make it so. Some of these factors probably are related to the teacher himself, some probably are related to the pupil and others to the physical situation in which the learning takes place. Some, no doubt, are related to the community itself. Mark Hopkins and the log may have provided effective learning in one type of situation, but there is grave doubt concerning the efficacy of this pattern under different circumstances.

The Problem of this Study

This study has been concerned with the effectiveness of science teaching, particularly with science teaching at the secondary school level. It has been concerned first, with determining factors of effectiveness in the teaching of science, and second, with making certain applications of these principles to existing teaching conditions.

The problem of the study is stated in the following questions:

1. What factors are related to the effectiveness of a learning situation in secondary science?
2. To what extent is there evidence that these factors are observed or neglected in the teaching of science in the public secondary schools of Ohio?
3. What evidence exists that "factor effectiveness" of a teacher actually is related to "over-all effectiveness" of the teacher?
4. What steps may be taken to increase the effectiveness of science teaching in Ohio's secondary schools?

Definitions and Assumptions

For purposes of this study, "secondary science" has been defined as any of the subjects, usually considered to be scientific in nature, which currently are being taught in the public secondary schools of the nation. Excluded were those subjects, semi-scientific in nature, but which more properly fall under the heading of physical education, vocational training, or the commercial or social areas.

A listing of the subjects which have been considered under the classification of "secondary science" and which actually were being taught in one or more Ohio high schools has been included in Table CCLXXXIII, Chapter VII.

A democratic philosophy of education has been assumed. Thus the "factors of effectiveness" which have been determined and studied were those which appeared to be of importance consistent with the ends of teaching in a democratic society.

Delimitation of the Problem

In accordance with the definitions and assumptions, this study was limited to the field of teaching and learning in the area of secondary school science. It was limited to those problems of effectiveness which were felt to be valid in a democratic society.

Ohio was chosen as the locale for this study because of the fact that the investigator was thoroughly familiar with the organization of the various types of schools in Ohio, because of the fact that his center of educational interest was in this state, and because of the fact that his location within the state made it more readily possible to secure adequate and accurate data concerning conditions in this state than could have been done for any other state whatsoever. Additionally, Ohio is, in educational matters, fairly representative of several other states in the northern half of the United States.

The problem was limited to teaching and learning situations in the public secondary schools because of the fact that the introduction of the private and parochial schools would have complicated the work considerably beyond any probable values which might thereby have accrued to the study. It was considered that the private and parochial schools offered areas for other investigations, since the backgrounds and traditions of these schools differ rather widely from those of the public schools. While a study of teaching effectiveness in such schools would undoubtedly be of interest, it was felt that they should not be included in the present investigation.

For much the same reason, technical high schools were excluded, even though they are publicly supported. As nearly as possible, the study was limited to general high schools rather than to those which were established to perform one single educational function or a limited number of educational functions.

While the application of this study was limited to Ohio, outside opinion was used in setting up the criteria under which the problem was developed. It was not felt that "factors of effectiveness" in secondary school science teaching are limited to any geographical area, and in determining these factors, individuals from all states of the United States were queried. Expert opinion

was not confined to Ohio, and in most cases was not weighted in favor of Ohio.

Organization of the Study

Chapter II of this study discusses the methods and procedures used in investigating the problem. Chapter III is a review of the literature related to this study with a discussion of the studies which have pertinence for this one. Chapter IV presents data relating to the determination of the factors of effectiveness in science teaching and includes many suggestions given by individuals to whom the factor lists were sent. Chapter V discusses and presents data which indicate the general condition with regard to the professional education of Ohio's secondary school science teachers. Experience in terms of years also has been included for each teacher of science in the public schools of the State of Ohio. Many items relating to the physical conditions under which science is taught in Ohio's high schools have been presented in Chapter VI.

Chapter VII gives information relative to the types of subjects taught by Ohio's secondary-school science teachers, their teaching load in terms of periods per day, number of study halls per day, extra-curricular activities, number of different preparations per day, and number of pupils per day. Chapter VIII presents data concerning the personal and professional qualities of Ohio's

secondary-school science teachers which bear on the effectiveness of the teacher. Chapter IX is devoted to a resume of methods and techniques of teaching which were used by Ohio's science teachers, and to a short interpretation of the data presented. Chapter X presumes to give an "effectiveness rating" to a sampling of forty Ohio science teachers. This rating was accomplished by visitation, discussion with the teachers' immediate supervisor, pupil-furnished information, and information given by towns-people.

Chapter XI interprets the assembled data in the light of the problem itself, and with consideration given to the inadequacy of certain data. In the final chapter of the study, Chapter XII, recommendations have been made and conclusions have been drawn which relate to the study and to the problem of the study. Data have been tabulated throughout, and interpretations of tabular material have been made.

CHAPTER II

METHODS, TECHNIQUES, AND PROCEDURES EMPLOYED

Selection of Method

Because of the extent of this study, no single method could be chosen which would be applicable to all phases of the work. It was necessary to use one method in determining and validating the "factors of effectiveness" and to use variations of another method in making application of these factors to science teaching in the secondary schools of the State of Ohio. These methods, techniques, and procedures, together with reasons for their use, have been presented in the following paragraphs.

The Factors of Effectiveness

The method of expert opinion was used in dealing with the factors of effectiveness. The combined judgment of many individuals, each of whom has a vital interest in the matter, was adjudged to be a satisfactory method of obtaining and validating a list of such factors. By using the opinions of men and women who are interested in the various facets of this problem, the investigator has, in effect, been able to project himself into many situations, and to see situations through many pairs of trained eyes.

Determination of the factors was made as follows: After careful reference to current literature, a tentative list of factors

of effectiveness in science teaching was prepared. This list was compared with factors which had been under discussion in books devoted to science education, those devoted to education in general, and in articles in the current literature of science education.¹ The list was submitted to several individuals in the science education field for comment.

Using this first list as a base, a second draft of "probably important factors" was prepared and sent to other individuals, then a final draft was prepared (see appendix). This final draft was submitted to members of certain organizations for their approval, rejection, or qualified approval or rejection of each of the seventeen individual items or factors of probable importance. The groups used were as follows:

The list of factors was submitted to the total membership of the National Association for Research in Science Teaching. This group was selected because in its ranks are found almost all of the individuals who are the professional leaders of science education as such in the United States today. The NARST, more than any other national organization, is concerned with the education of science teachers. Most of the individuals of whom the group is composed are actually engaged in the preparation of science teachers.

¹

See Chapter III, footnotes 60-82 inclusive.

The factor list was sent also to a sampling of two hundred-fifty members of the National Science Teachers Association. This sampling was selected at random from among those members of this organization who have an expressed interest in the teaching of secondary-school science. Most of the individuals queried were teaching high school science at the time of the study. This group was chosen in order to get opinion from professionally minded individuals who were in position to view science teaching first-hand.

The third group to which the factor list was sent was a sampling of members of the American Association of School Administrators. This group was queried because the individuals concerned were believed to be in position to view science teaching as a part of the entire school curriculum, and to be able to see science teaching in perspective. For much the same reason, members of the National Association of Secondary School Principals were queried. In both of these groups, there was weighting in favor of the State of Ohio. In neither of the science groups was any weighting done. The reason for weighting in favor of Ohio insofar as the superintendents and principals were concerned was because application was to be made to the State of Ohio. It was considered that because of application to this state, the views of those who supervise the work of science teachers in the state should be considered rather carefully.

Application of the Factors of Effectiveness

After the returns from the "factor" opinionnaires had been tabulated and evaluated, a study was made to determine which of these factors adjudged valid by the respondees would lend themselves to various possible techniques of investigation. Certain factors seemed to admit of study on a state-wide scale, while others appeared to be so intimately concerned with the teacher himself or with the relationship between the teacher and other individuals as to defy mass methods of data gathering.

Particularly difficult to measure by mass methods are those factors which accrue from variations in teacher personality, those which relate to the relationship between a teacher and his pupils, and those which relate to the relationship between a teacher and his supervisor.

The succeeding paragraphs indicate the procedures used in making application of the factors of effectiveness to science teaching in the public secondary schools of Ohio.

Factors Related to Training and Experience

Experience gained in an earlier study had indicated that records of training and experience submitted to the Ohio State Department of Education are more likely to be accurate than similar reports furnished "off-the-cuff" by the teachers themselves. Therefore, since it was the opinion of the great majority of those replying to the original questionnaire that there are certain factors of teaching

effectiveness closely allied to amount and type of training and experience, the permission of the State Department of Education was obtained to examine the most recent reports submitted by the principals of Ohio's high schools. A copy was made of the training and experience data relating to each Ohio secondary teacher who was teaching one or more classes of science, with the exceptions already noted and with the exception of two schools whose principals had not submitted annual reports at the time of this study. These data were taken for the school year 1950-51.

The two schools which had not submitted reports were not considered further in the survey, and all figures included in this study are non-inclusive of the few teachers teaching science in these two schools.

These data,² furnished a variety of information concerning the teachers of science in Ohio in addition to that information which was sought originally.

Factors Related to Conditions for Teaching

Since a great majority of the individuals replying to the "factor" questionnaire believed that the physical conditions surrounding the teacher have an effect upon the teaching, it was believed necessary to make use of certain state records for a portion of the information concerning physical conditions in the science departments of the public secondary schools of Ohio. The state department opened its confidential files of the reports of the state high school

examiners for the purposes of this study. While such files are not strictly up-to-date, they do furnish a good over-all picture of the general situation at least in so far as certain conditions exist. No record was more than three years old at the time of the survey, and many records of visitation were relatively recent, having been made a few weeks or months prior to the beginning of this study.

The state reports were of value also because of the fact that the picture was given through the eyes of a small number of men (four) who view all of the schools of the state. These high school examiners form the one group of individuals in the State of Ohio which visits all of the secondary schools. Their view should be broad enough to give validity greater than that which would attend visits to a small number of schools in limited areas in the state. Additionally, they report without the bias which an individual teacher develops for his particular situation. Information from these reports was recorded on a form,³ and has been interpreted in Chapter VI.

Information Obtained from the Teachers

After obtaining as much data as possible from other sources, it was decided that much information of value concerning certain

²

See Chapter V. Also see appendix, Form A.

³

See appendix, Form D.

of the factors of effectiveness could best be obtained at state-wide level from the teachers themselves. Accordingly, a form was prepared which embraced questions concerning the teacher and his methods of teaching. A copy of this form,⁴ was sent to every teacher in the state who was teaching one or more classes of science, with the exceptions noted previously. This form, extensive in its coverage, was prepared after consultation with individuals in the United States Office of Education who had recently submitted a similar questionnaire in the subject area of biology on a nationwide small-sampling basis.⁵ Results of the questionnaire have been considered in succeeding portions of this study, but briefly it may be said that the percentage returns on this questionnaire as on the earlier opinionnaires was considerably beyond that which usually is considered satisfactory on an extensive study. No follow-up was attempted.⁶

In transcribing and interpreting data, returns for county schools were kept separate and were considered and analyzed separately from those of city schools. In some instance the teachers of exempted villages were considered separately, but in most cases they were considered of a class with the county schools. This classifi-

⁴

See Appendix, Forms B and C.

⁵

Philip G. Johnson and Edgar Martin. See Chapter III, footnote 23.

⁶

Refer to Chapter VIII, Table CCLXXXIV for percentage returns.

cation was made when in the judgment of the investigator there were no significant differences between data submitted by and for teachers in exempted villages and their counterparts in the county schools.

The Sampling of Forty Teachers

In preceding paragraphs, hints have been given that certain factors of effectiveness, particularly those in the "intangible" areas are difficult to consider by any of the mass methods employed in other portions of the study. Intangibles, while of extreme importance, have a way of slipping through the net when items suitable for general evaluation are prepared. It is difficult to draw fine inferences concerning teaching personality, for example, at a distance and with only the medium of written answers to rather general questions. Nevertheless, there seems to be no single factor more conducive to teaching effectiveness than the rather complex factor of fine teaching personality. Certainly if we wish to relate factors of effectiveness to teaching in a given area, some attempt must be made to develop this relationship. The matter cannot be ignored, neither can it be measured as semester hours of credit are measured. While we may and often do make certain assumptions about an individual's preparation in chemistry, for example, by noting the number of semester hours of credit in the subject, we have no such long-distance and mass quantitative way of drawing inferences with regard to teaching personality, with the influence

of the teacher in his classes and in the school, with the place of the teacher in the affections and regard of his community and with a number of other so-termed "intangible" factors.

It was necessary, therefore, to proceed directly in this matter of obtaining evidence concerning personality factors and other similar factors. Choosing a number of representative science teachers (40 in all) in various types of public secondary schools, and in various parts of the state, their situations and their personalities were studied closely through the eyes of the observer, the principal or supervisor of the teacher affected, and in many cases through the eyes of students, fellow teachers, and even townspeople. No standard method was used because conditions differed from one situation to another. The only pattern followed, if it may be called a pattern, was to obtain the most information about the given teacher which it was possible to obtain by any means not harmful to the teacher. The observer talked with principals, superintendents, supervisors, listened to pupil conversation, in some cases saw the results of pupil-rating sheets,⁷ and observed teachers personally. In a few cases information was available which was pertinent even though it came from sources as far removed as the teacher-preparatory institution which had kept in contact with the teacher. In one case some implementing information came from a state department of education representative. In no case

7

See Appendix.

was a teacher included when the investigator felt that there was insufficiency of information for reasonably accurate interpretation of the teacher in his situation.

No claim is made for complete representativeness of sample, but teachers have been included from some of the very smallest of Ohio's schools and from some of the largest as well as from several between the extremes. Cities, exempted villages, and county schools have been included. Several excellent teachers were studied, a few of which might even be called master teachers. Several teachers were included who would rate as "good" but not excellent. Some were fair, and there was a sprinkling of poor teachers. All contributed somewhat to the total picture.

Summary

This study did not rely on the use of any one technique, although the questionnaire and opinionnaire were used to a considerable extent. The case study method also was used, as well as the method of examination of collected data. As has been noted, a direct study of the annual reports of the high school principals of Ohio was made to determine information which could be gathered more accurately and more speedily in this fashion. Reports of state examiners of schools also were used. Throughout, an attempt was made to use that method or technique which held the promise of giving the greatest amount of relevant data considering the expenditure of time and consonant with reasonably accurate reporting.

CHAPTER III

RELATED STUDIES AND A REVIEW OF THE LITERATURE

INTRODUCTION

Many investigations have been made and much has been written concerning various areas related in one way or another to the purposes of this study. An effort has been made to determine the extensiveness of the pertinent literature concerning the following topics:

1. Science teaching in the secondary schools.
2. The secondary teacher of science.
3. The preparation of the secondary teachers of science.
4. The condition of high school science furnishings, equipment, and rooms.
5. The effectiveness and competency of the teaching of secondary school science.
6. The extent and type of science offerings in the secondary schools.
7. The objectives of science teaching in the American secondary school.
8. The philosophy of the American secondary science teacher.
9. The place of community resources in secondary science teaching.

Studies Dealing with the Status of Science Teaching

As a portion of a study concerned largely with determining the factors which contribute to achievement of certain objectives in science, Anderson¹ made a study of the status of science teaching in certain Minnesota high schools during the year 1946-47. He used ninety-one teachers as a sampling and selected them from teachers of two sciences, biology and chemistry. He obtained his information by means of a fifty-eight-item questionnaire which was submitted to the group of teachers.

The items investigated by Anderson were roughly comparable to those of the present study, but were not identical. He checked, for example, conditions (as related by the teacher) concerning teaching load, number of pupils handled per day, class size, length of period, formal preparation of the teacher in science, and in mathematics, experience, type of institution from which the teacher was graduated, academic degrees held, use or non-use of workbooks, order of laboratory instruction, use of demonstration procedure, types of laboratory procedure, number of hours per week of laboratory work per student, type and size of laboratory, science supplies, laboratory equipment, procedures

1

Kenneth E. Anderson, The Relative Achievement of the Objectives of Secondary School Science in a Representative Sampling of Fifty-Six Minnesota High Schools. Doctoral thesis. Minneapolis: University of Minnesota, 1949. 288 p. (Typewritten).

employed to develop an understanding of scientific principles, - to habituate students to scientific attitudes, - to develop the ability to use the scientific method. He also asked questions concerning the teachers' own knowledge of the scientific method. Questions were asked relating to science clubs in the high school, to field trips, the use of visual aids, the amount of professional reading done by the teachers and the use of science periodicals in classes. While no questions were asked concerning affiliation in professional organization, a related question concerning attendance at professional meetings was given. Finally, questions relating to objectives in teaching and to differentiation in teaching were answered by the teachers who co-operated in Anderson's survey. He also requested information from the teachers concerning their ideas about means for improving instruction in science in the Minnesota schools.

The present study differs from that of Anderson in size of sampling, and in method used. Whereas Anderson relied totally on information furnished by the teachers selected, the present study has been carried out in part on a state-wide base. Additionally, in that portion of the present study which dealt with a small number of teachers, opinion was obtained not only from the teachers, but also from other individuals concerned with the teaching situation. Many of Anderson's queries to teachers were very similar to those which formed the basis for the application portion of the present study.

As one of a continuing series of status studies by the United States Office of Education, Johnson² during the school year 1947-48 received replies from 715 secondary schools in the United States to a questionnaire seeking information concerning many phases of their science teaching programs. Included were questions which dealt with the status of science teaching as such. While some of the items in the Johnson survey closely approximate in intent similar items in the present study, there is a considerable difference in the over-all effect of the study. Additionally, the Johnson report covers a total of 715 schools scattered over the entire United States, while the present study is state-wide in coverage, and (considering the number reporting) gives a more adequate representation in the area it purports to cover.

In his status study, Johnson investigated percentages of students enrolled in the various sciences, percentages of boys and girls enrolled in the sciences, type and sex of science teachers, average class size, grade placement of the various sciences, alternation of science subjects, number of periods per week devoted to the various sciences, and troublesome problems relating to the teaching of science. Several other items also were included.

2

Philip G. Johnson, The Teaching of Science in Public High Schools: An Inquiry into Offerings, Enrollments, and Selected Teaching Conditions, 1947-48. U. S. Office of Education Bulletin 1950, No. 9. Washington, D. C.: Government Printing Office, 1950. 48 p.

Crouch³ used the visitation method to study the status and needs of Negro high schools in Tennessee during the year 1946. Jointly sponsored by Tennessee A. & I. College and the Tennessee State Department of Education, Crouch and a staff of assistants visited 20 of the Negro high schools of the state, a number representing 28.1 per cent of the approved Negro secondary schools of that area. As might be expected in a study of this type, the needs of the schools have been brought into sharp focus by the descriptions of present status. This study relates to the present study chiefly in the comparison which is given between the Negro high schools of Tennessee and the public high schools of Ohio as concerns education of teachers, quality and type of equipment, degree of experience of teachers, and breadth of science offerings. Outlay of money for science equipment and supplies, goals of teaching, methods of teaching, and desirable changes in preparation of teachers for these schools also were considered. In all areas where in comparison was possible, the schools covered in Crouch's survey rated much lower than the Ohio schools.

While not in the nature of an investigation, the work of the Co-operative Committee on the Teaching of Science has made a considerable impact on the thinking of science teachers in schools

3

H. B. Crouch, A Preliminary Report on a Study of Science Education in Negro High Schools of Tennessee. Nashville, Tennessee: Tennessee A. & I. College, 1947. Pp. 11 + 140. (Mimeographed).

and colleges. The December 1944 report of this committee⁴ outlined a rather gloomy picture of the status of science teaching in the secondary schools of the nation. This committee was particularly disturbed by the low enrollment and evidence of poor teaching in the physical sciences. This committee found evidence of teachers who were poorly prepared, of teachers teaching in areas in which they had little competence, and of schools which were so limited in enrollment as to have little future opportunity to do a better job of teaching than they were currently doing. Except for the point concerning low enrollment (which this investigation did not enter into) the present study did investigate the other areas covered by the Co-operative Committee.

As a result of a questionnaire covering biology teachers who teach "6.0 per cent of the secondary school pupils of the nation, in schools enrolling at least 40.0 per cent," Riddle⁵ has made one of the most important studies to-date concerning the teaching of biology in the United States. Using a total of nearly 16,000 questionnaires directed to biology teachers all over the nation, many phases of the subject were covered. Part of the questionnaire concerned the status of the teaching of biology in the schools sampled.

4

Co-operative Committee on the Teaching of Science. On the Teaching of the Basic Sciences. (Reprint from American Journal of Physics, 12:359-62; December 1944.)

5 Oscar Riddle and others, The Teaching of Biology in Secondary Schools of the United States. The Committee on the Teaching of Biology of the Union of American Biology Societies, 1942. 76 p.

These included questions relating to the buildings, equipment, and the text-books used by teachers of biology in the schools. As a result of the study, conclusion is given that "An analysis of replies from the questionnaire shows that in very many schools these facilities leave a great deal to be desired, and that, as in other aspects of our problem, there are marked differences between various regions and between schools in large and in small communities."

"Total and average values, as tabulated here, should be read with an understanding that rural schools and Southern schools are inadequately represented in the schools reported in the questionnaire."⁶

Bearing out the conclusions as given by Riddle, poor buildings were reported by 3.7 per cent of the cities, while 8.7 per cent of the rural groups reporting believed their building to be poor. Similarly, 14.4 per cent of the city groups reporting said that their science room was not equipped for science, while with the rural groups 30.0 per cent were found to be not equipped. Poor equipment marked the science rooms of some 9.9 per cent of city schools while rural teachers reported similar conditions in a relatively astonishing total of 61.7 per cent of the cases. In the matter of field trips, however, rural and town schools do much better than do the cities.

6

Oscar Riddle, op. cit., p. 37.

Over three-fourths of the rural and town schools use field trips as compared with a little less than half of the city schools reporting. The conclusions which have significance for this study are given as follows:

The facts as set forth here need little further comment. Evidently equipment and conditions for work are far less satisfactory, the country over, than could be desired. Schools in cities, with their much stronger financial support, are better off than in towns, and very much better than those in rural districts. It should be remembered, however, that country schools are in a much more favorable position to teach biology directly than are city schools and that their pupils have a better general knowledge of living things from their own experience outside the class-room than do pupils in city schools, so that partial compensation for poorer equipment is thus possible.⁷

Similarities between the Riddle survey and the present study are not hard to find. Chief differences occur in that the Riddle investigation was concerned entirely with the teaching of general biology and with the fact that it was simply a status study. Many of the conditions discovered on a nation-wide scale by Riddle have been duplicated in the findings of the present study, to a greater or lesser degree.

Studies dealing with the status of the science teacher

There have been a number of studies in recent years dealing in whole or in part with the status of the science teacher. Some

7

Oscar Riddle, op. cit., p. 42.

of these have concerned the work week of the teacher, some have been concerned with the extra-curricular responsibilities of teachers, some with the position of the teacher in the community, and some concern teaching load, professional qualifications, professional activities as well as certain other factors having to do with the science teacher in his teaching position.

A relatively recent study on the status of science teaching on a state-wide level was made by Graham⁸ in the State of Massachusetts. Using a questionnaire which was submitted to all high schools in the State, Graham discovered certain conditions which have significance for the present study in that direct state-to-state comparisons may be made of certain items.

Dividing the high schools of the state into four groups in order of size, Graham attempted to analyze the teaching of biology by reference to certain types of equipment in use, and to certain practices of the teachers in organizing and directing the work of their classes. He classified his data into four classifications as follows:

1. Facilities for Teaching Biology in the High Schools of Massachusetts.
2. Approximate Number of Field Trips Taken per Year.
3. Number of Subjects Taught by High School Biology Teachers.

4. Total Number of College Courses Taken in Biology by the High School Biology Teachers.

Under the first topic he included microscopes, movie projectors, dissecting kits, aquaria, lantern slide projectors, terraria, opaque projectors, animal cages, greenhouses, observation beehives, school gardens, school camps, microprojectors, charts, preserved specimens, live specimens, and models. These varied in prevalence in schools from 89 per cent of the schools having microscopes and movie projectors down through 26 per cent having microprojectors to zero schools having school camps.

This investigator found that almost half of the schools have no biology field trips at all, while 42 per cent have from one to five per year and only a negligible fraction have more than ten per year. One-fifth of the Massachusetts schools responding said that their biology teacher taught no other subject, while 30 per cent show him teaching one other subject, and almost a fifth each show the teacher as teaching three or four subjects including biology. Of the teachers, 59 per cent either majored or minored in biology, and two per cent had no biology at all. While it is difficult to make exact comparison between Graham's study and the present study, there are many areas of similarity. Graham's study of frequency of biology field trips and of use or non-use of certain types of biological equipment in Massachusetts, may be compared with similar figures for science in Ohio.

Three separate studies were combined in a report published recently by the National Science Teachers Association entitled Teaching Conditions and the Work Week of High School Science Teachers.⁹

The first of these three studies was conducted in New York State by Brandwein and others¹⁰ and was accomplished by circulating a questionnaire to a sampling of one teacher of every five named on a list which included practically all of the science teachers of the state. This inquiry sought information concerning certain items which are of importance in the present study, and certain others which this study does not include. Reactions were obtained relative to the number of preparations, class size, and non-teaching responsibilities of the teachers. Inquiry further was made concerning equipment and materials, budgetary allotment for science materials and equipment, and opportunities for professional growth. The teachers reported on the extent and type of their pre-professional training with especial reference to their present teaching assignment.

The second of the three studies was conducted by Harold Wise,¹¹

⁹ National Science Teachers Association, Teaching Conditions and the Work Week of High School Science Teachers. Bulletin 1947-48. Washington: NSTA, 1948. 18 p.

¹⁰ Ibid., pp. 5-10.

¹¹ Ibid., pp. 11-15.

and also was a questionnaire study. From a composite of answers received from 135 principals and 172 teachers distributed among approximately half of the states and Puerto Rico, judgment was obtained regarding several phases of the high school science laboratory situation. Results obtained from this study were gratifying to those who believe in the necessity for laboratory experiences, although this study dealt with belief rather than current practice, and so had only limited pertinence to the present study.

Glenn¹² carried out the third of the studies represented, using as a basis for his investigation replies received from 217 science teachers distributed among 38 states. In certain respects, Glenn found evidence to indicate a critical condition in the working conditions of a great number of science teachers. His results paralleled to a considerable extent the results found in the present study.

The second and third portions of the NSTA report have considerable significance for the present study in that they discuss at national level certain items which have been studied in Ohio on a state-wide level, but perhaps more intensively. The first part of the study is significant in that it affords some measure of comparison between Ohio and New York on a few matters which are studied in the present investigation.

12

Ibid., pp. 16-16.

The entire Riddle report¹³ but particularly Chapter I has considerable significance in dealing with the status of the science teacher. Of the 3160 reports received by this committee, 215 were completed by teachers of biology in Ohio's public schools. Thus, in addition to the nation-wide coverage of the Riddle report, a very good sampling was obtained from Ohio. Those items which seem of most significance so far as the present survey is concerned include items relating to subjects taught by the teachers included in the sample, subjects preferred by the teachers, and the experience and professional interest of the teachers reporting.

Differences between the results found in Riddle's study and the present one appear to arise from the fact that the Riddle report was weighted in favor of the larger schools.

Pruitt¹⁴ summarized four studies made in 1940 in Oklahoma. Of the four, three have some significance in the present study. Investigations were made concerning the length of teaching experience in public high schools, years of teaching in present position, highest degree obtained by teachers, amount of training and type of training in the various sciences, a relation of monthly salaries with the amount of professional training presented by the teacher, and the

¹³

Oscar Riddle, op. cit.

¹⁴

Clarence M. Pruitt, "Science Teaching in the High Schools of Oklahoma," Science Education, 27:122-126, December 1943. Reviews studies made by James W. Payne, Argus F. Smith, Sister Mary Lawrence Franz, and Olen M. Self.

same comparison between salary and total experience. Teaching combinations also were studied, as were opportunities for in-service education. Membership in professional organizations was requested, and professional reading was queried. Additionally, certain minor points such as teachers' use of museums were covered. Altogether this group of four studies probably furnished a good picture of conditions in the Oklahoma schools in 1940 with regard to many aspects of the teaching of science. Whether the generally low conditions reported in Oklahoma have been remedied during the years is not known. Where comparisons were possible Ohio teachers of science in 1951 appeared to rank somewhat better than Oklahoma teachers of 1940.

In his Nebraska study, Engel,¹⁵ using records available in the Nebraska State Department of Education made certain determinations concerning the status of teachers in that state for the 1948-49 school year. His study is significant to the present study chiefly in that it makes possible a comparison of certain factors on a state-wide basis. Just as Engel obtained data which concerned every science teacher in the state, so the present study has obtained (in some cases) duplicate data for Ohio and under very similar circumstances. He dealt with amounts and types of pre-professional

15

Marion Engel, A Study of the Preparation, Assignment, and Experience of Science Teachers in the State of Nebraska. Master's thesis. Lincoln: University of Nebraska, 1950. 68 p. (unpublished).

training, with numbers and percentages of degrees of various types, and with the numbers and types of subjects taught, as well as with several other items having lesser significance.

In an Ohio study, Ferguson¹⁶ has used certain data to analyze the status of science teachers in the secondary schools of Ohio. This study is discussed further in a later section of this report, since it has special significance. (See Chapter V).

DeLoach¹⁷ has approached one phase of the problem in obtaining and classifying information concerning the subjects taught by chemistry teachers in Alabama during a recent school year. He found much the same conditions prevailing as were found in Ohio.

While ostensibly concerned with problems of science teaching, no study of the type made by Crouch¹⁸ could avoid direct concern with the status of the science teacher. Inasmuch as Crouch was apparently concerned with the teacher more as a part of the total science teaching picture, his study does not have as much significance in this respect as it has in connection with the status of science teaching as a whole.

The American Council on Education¹⁹ devoted much thought to characteristics of good teachers, and in so doing dealt at length

¹⁶ Thomas Currier Ferguson, The Status of Science Teachers in Ohio Public Secondary Schools. Master's thesis. Columbus: The Ohio State University. (unpublished). pp. 1 + 90.

¹⁷ Will Scott DeLoach and Mrs. Auborn Russ Hall, "Subjects Taught by High School Chemistry Teachers, Alabama, 1948-49." Science Education, 35:259; December 1951.

¹⁸ H. B. Crouch, op. cit.

¹⁹ Commission of Teacher Education, Teachers for Our Times. Washington, D. C.: American Council on Education, 1944. 176 p.

with teachers as they now appear to be. Showing that the average age of teachers is increasing as the years go by, the Council saw this item as an indication that teachers are remaining in the field of education, thus calling for training which fits the teacher to be a permanent member of a profession. Using certain usually accepted arguments, the Council called for aid to teachers already in service, by implication indicating that the present status of the teacher leaves something to be desired in certain respects. The present study tends to furnish data in support of the Council's position, at least so far as city schools are concerned.

Winans and Jean²⁰ have made one of the few studies which concerns itself in its entirety with the status of science teachers. Discussing chiefly the educational and professional characteristics of Colorado science teachers, this study covered both full- and part-time teachers of science in that state. Data were obtained by using a questionnaire, and were concerned with such items as science teaching combinations of full- and part-time teachers, the leading subjects taught outside the science field, amount of credit earned by the teachers, undergraduate majors, and types of professional courses taken by the teachers of the state. These

20

Ada E. Winans and F. J. Jean, "The Educational and Professional Status of Science Teachers in the Public Schools of Colorado." Science Education, 29:133-36; April-May 1945.

investigators concluded that science teachers in Colorado were being forced to teach too wide a variety of subjects. The present study included all of the items used by the Colorado investigators.

Nicholls,²¹ in his study of Nebraska science teachers, obtained his data from the high school reports sent to the office of the State Superintendent of Schools. He included only public senior high schools in his listing, studying the records of 662 secondary science teachers. He concludes:

The typical science teacher in Nebraska is a man who teaches mathematics in addition to science, has a Bachelor's degree from a state teacher's college of Nebraska, coaches athletics, has between six and seven years of teaching experience, has been in his present position three and a half years, has no administrative duties in connection with directing the school in which he works, receives a yearly salary of \$1,145.49 and has no graduate work.

The present study could not make such a clear-cut description of the "typical" Ohio science teacher, but did cover all of the items listed in the Nicholls study.

Miller²² has furnished a summary which is in most respects similar to the chapter in Riddle's report previously cited. He found that based on the results of the 3186 questionnaires returned, about two-thirds of all biology teachers are men, that the subject

²¹

Wayne Nicholls, "Status of Nebraska Science Teachers." Science Education, 25:213-5; April 1941.

²²

D. F. Miller, "A Summary of Part of the Questionnaires sent to Teachers of Biological Sciences in Secondary Schools." The American Biology Teacher, 3:221-7; April 1941.

most frequently taught in combination with biology is general science, and that biology teachers belong, on an average, to slightly less than two professional organizations.

As a result of the answers to a questionnaire issued by the United States Office of Education, Martin²³ has issued a report covering the first one hundred completed questionnaires received. The final report has not yet been released. This questionnaire was given nation-wide circulation on a sampling basis and included some questions relative to the status of the science teacher. These largely concern class size and certain teaching practices.

In addressing questionnaires to junior and senior high school principals of third class school districts in Pennsylvania, Wright²⁴ determined that some 80 per cent of the science teachers in such schools taught not more than two subjects when the basic subjects were biology and general science. Approximately 60 per cent of the chemistry and 40 per cent of the physics teachers taught not more than two subjects. He found that in these districts slightly less than one third of the science teachers taught one subject only.

In a study of the status of some forty teachers in a number of colored high schools in Louisiana, Lee²⁵ found that of the forty,

²³ Edgar Martin, "The Present Status of Instruction in General Biology." The American Biology Teacher, 13:149-51; November 1951.

²⁴ William A. E. Wright, "Subjects Taught by Science Teachers in Third Class School Districts of Pennsylvania." School Science and Mathematics, 45:45-53; January 1945.

²⁵ J. Warren Lee, "Status of the Natural Science Teacher in Negro High Schools of Louisiana." Science Education, 34:36-40; February 1950.

only 21 were certified in the sciences, one in mathematics, and the remaining sixteen in fields unrelated to science teaching. His study also dealt with types of degree, years of experience, types of certificate held, and with subjects taught by the teachers in addition to science. It indicated in general that conditions as they related to the status of the Negro teacher of science in Louisiana leave some things to be desired. All of the points covered in Lee's investigation were paralleled in Ohio in the present study.

Much earlier, Curtis²⁶ had determined that in the area covered by the North Central Association, there was paucity of professional reading among the secondary science teachers, a fact which the present study bore out.

Studies Dealing With the Preparation of Science Teachers

The Engel study²⁷ previously quoted gives a measure of comparison between teachers in Ohio and those in Nebraska in such matters as number of credit hours in science, average number of hours presented in professional education subjects, and numbers and types of degrees possessed by the science teachers of the two states. Additionally some comparison is possible between the two states with regard to the number of science teachers who have graduate

²⁶ Francis D. Curtis, "The Teaching of Science in the Secondary Schools of the North Central Association." Science Education, 17:1-11; February 1933.

²⁷ Marion Engel, op. cit.

credit. The fact that only two years separated the two studies gives the Engel study greater significance for this investigation than it otherwise would have.

Further comparison is made possible by using the data presented in the Riddle²⁸ study. It may be of interest in making comparisons between the data of the two studies to note that the Riddle group feel²⁹ that their study "probably contains too many well trained men and women to be considered wholly representative." The Riddle survey used as a basis for tabulation the teachers' own estimates of their amount of credit, whereas the Engel study and the present study used the records of the teachers as filed in the respective state departments of education -- a procedure which is likely to give a more accurate account of college preparation.

The Riddle study³⁰ holds that the results of analysis of data indicate that "The average teacher has a fairly broad training in sciences, andthe teachers approve this state of affairs." Both the Engel study and the present study cast some doubt on the validity of this conclusion, at least insofar as the states of Ohio and Nebraska are concerned.

In an unpublished investigation, Pontius³¹ studied certain

²⁸ Oscar Riddle et al., op. cit.

²⁹ Oscar Riddle et al., op. cit., p. 36.

³⁰ Oscar Riddle et al, loc. cit.

³¹ John Pontius, A Survey of the Training and Methods of Teaching General Science. Master's thesis. Muncie: Ball State Teachers College, 1949.

conditions which existed in the training pattern of a number of Indiana teachers. He found that 91.4 per cent had their baccalaureate degrees, 17.2 per cent a master's degree. He found that 81.7 per cent of his sampling of teachers claimed a college major in science and (which has considerable significance for the present study) 38.7 per cent claimed experience or training in the science field aside from their formal education.

Using data obtained from the files of the Alabama State Department of Education, DeLoach³² determined some facts concerning the preparation of teachers of chemistry in the southern state. Included in the DeLoach study were data concerning the preparation, in terms of semester hours of chemistry, mathematics, and physics of white chemistry teachers, and a determination of the time and place of undergraduate training of a relatively large group (195) of chemistry teachers. Of this group of white teachers, DeLoach indicated that 78 per cent had attended college in Alabama, 70 per cent graduated from Alabamaschools. Of this group, 13 per cent graduated from the University of Alabama, 16 per cent from Alabama Polytechnic, 18.5 per cent from Alabama State Teachers College, 22 per cent from liberal arts colleges in Alabama. Recency of training was indicated by the fact that 25 per cent were from zero

Will Scott DeLoach and Mrs. Auborn Russ Hall, two articles to be published in Science Education entitled "The Undergraduate Preparation of High School Chemistry Teachers, Alabama, 1948-49," and "Time and Place of Undergraduate Training of a Group of High School Chemistry Teachers."

to five years out of college, while 58 per cent had been out of college less than 15 years.

In Oklahoma, Pruitt³³ and his co-workers found that, as might be expected, teacher training as represented by number of semester hours in the science field was in somewhat worse case in small high schools than in large, but that the picture was not too bright in either. A summary of Pruitt's findings is given as follows:

In small high schools, 11 science teachers had no college degree, and 48 had a master's degree; 46 had no biology, 121 had no physiology, 73 had no physical science, and 349 had no geography. In physical sciences, 343 teachers in small high schools had a total of 2297 hours in chemistry and only 377 semester hours in physics.

In the large high schools, the physical science median of 18.11 semester hours was divided as follows: Chemistry, 9.45, physics 7.67, geology 5.84. In the large high schools 98 (of 534 science teachers) had no college biology, 436 no physiology, 84 no physical science, and 410 no geography.³⁴

In one of the early studies which was concerned partially with the preparation of science teachers, Curtis³⁵ found that in the secondary schools of the North Central Association, some 20 per cent of the men and 31 per cent of the women science teachers submitting data had less than 30 undergraduate hours of science credit.

³³ Clarence M. Pruitt, op. cit.

³⁴ Clarence M. Pruitt, op. cit.

³⁵ Francis D. Curtis, "The Teaching of Science in the Secondary Schools of the North Central Association," Science Education, 17:1-11; February 1933.

Boone and Jameson³⁶ found that in 1934, 13 per cent of 855 teachers in California junior and senior high schools had no college training relative to the subjects being taught. They estimated the percentage of adequately trained teachers at that time to be not over 40 per cent of the total number of science teachers.

Mallinson and Sams³⁷ investigated the relation between the number of semester hours in college science acquired by a student teacher and his competence in the area as manifested by test scores. Further investigation was made of the minimum number of hours of college science required by student teachers in order that they be able to demonstrate the same competence in tests as demonstrated by high school students who were majoring in science. This study is of significance chiefly because it tends to show that competence in science is in some respects at least, related to semester hours of science presented by the student teacher.

Ford³⁸ investigated the teacher education requirements of 36 institutions in the North Central Association area by studying the catalogs of these institutions. While there may be objections to a report based solely on this type of evidence, some conclusions

36

Eleanor J. Boone and A. Pringle Jameson, "The Training of Science Teachers Serving in the California Schools." California Quarterly of Secondary Education, 9:350-9; June 1934.

37

George G. Mallinson and Conway C. Sams, "An Investigation of the Subject Matter Competence of Student Teachers in Science." School Science and Mathematics, 51:461-9; June 1951.

38

Leonard A. Ford, "Science Curricula of Teachers Colleges." Science Education, 25:95-97; February 1941.

were possible. His general conclusion was that in the institutions whose courses were studied, few of them required enough work in the entire science field to prepare for teaching the sciences offered in the high school. This conclusion is indeed pertinent to the situation in Ohio.

Brandwein³⁹ queried a fairly large sampling of teachers about their opinion of the adequacy of their pre-service training. He found that about half of these teachers felt their training to have been inadequate in at least one of the subjects which they were called upon to teach. Inadequacies were felt not only in subject matter preparation, but also in methods courses as well. Responses to the questionnaire reveals that many teachers believe their methods courses to have been poor. Brandwein concluded that in the light of this survey, "In general, schools with one or two science teachers are forced to make assignments for which preparation is inadequate, while the larger the school the less is the likelihood of assignment to a subject for which the teacher is not prepared."⁴⁰ The Brandwein study has pertinence to that portion of the present study which deals with the teacher's own concept of his effectiveness.

³⁹ National Science Teachers Association. Teaching Conditions and the Work Week of High School Science Teachers. Bulletin 1947-48. Washington: NSTA, 1948. Chapter I.

⁴⁰

Ibid., p. 9.

Benner⁴¹ analyzed topics in general science textbooks and in courses of study with a view to determining whether teachers who met minimum certification standards in various states would be likely to have training adequate to teach the various topics discovered. She concluded that the state minimum standards were insufficient to guarantee good preparation of general science teachers. She found these requirements particularly weak in the fields of agriculture, astronomy, bacteriology, geology and meteorology; fields from which so much general science content has been taken. Much the same weaknesses were studied in the present investigation.

Few investigators have delved deeply into the problems concerned with science education without making some attempt to devise a program of pre-service or in-service education designed to alleviate the ills which have beset the profession. Additionally, several committees have studied the question and have made recommendations concerning the education of secondary and elementary teachers of science. Also, many writers have, without reporting the results of exhaustive investigations, written articles asking that certain changes be made in the preparation of science teachers. For the most part these articles are based on the personal experience of the writer, and while perhaps not authoritative, should be reviewed by the student in the field, in the hope that

⁴¹ Gladys Vera Benner. The Preparation in the Special Sciences in Institutions of Higher Learning of the Teachers of General Science in American Public Secondary Schools. Doctoral thesis. Philadelphia: University of Pennsylvania, 1940. 151 p. (Typewritten)

indications of needed reforms may be found. Since these studies and investigations are not of primary importance to the problem of this thesis, they have not been reviewed individually. The interested reader may find many of them referenced in the bibliography.

Studies Dealing With Conditions of High School Science
Rooms, Furnishings and Equipment

Quite a number of studies have been concerned with adequacy or inadequacy of the science room and its furnishings and equipment. Included in some such studies have been data relating to the science budget, use of audio-visual aids by science teachers, presence and use of models, charts, and other such supplementary materials, questions relating to availability of workbenches, tools, and other needed equipment.

One such study, which has not been completely analyzed at the time this study was completed was made by the United States Office of Education⁴² and concerned the teaching of general biology. While much of the questionnaire requesting information from a sampling of biology teachers over the nation concerned other phases of the biology problem, a sizable part was concerned with the physical conditions under which biology was being taught. A pre-

⁴²

United States Office of Education, Inquiry Into the Teaching of General Biology, 1949-50. Printed questionnaire. Washington, D. C.: U. S. Office of Education, GPO. 1950.

liminary report of this investigation⁴³ may or may not be indicative of the complete findings.

In a statistical summary of data taken from annual reports of member secondary schools, the North Central Association⁴⁴ has listed the amount and condition of science equipment as reported by member schools. Data have been tabulated according to the size of the various schools ranging from the smallest to the largest. Amount and condition of science equipment was classified by the schools according to one of four classifications; superior, good, adequate, and unsatisfactory. Obviously, the classification selected by the school may be said to have been completely arbitrary, but on the other hand schools probably classified their science equipment in the light of their own particular needs, which should give some measure of validity to the reported results. Of the 431 schools reporting, 98 said their science apparatus was in excellent condition, 205 reported good apparatus, 109 said their equipment was adequate, and 19 reported an unsatisfactory situation. This study is of especial significance to the present investigation because it affords an area of direct comparison.

Probably the most complete study of this aspect of the

⁴³

Edgar Martin, "The Present Status of Instruction in General Biology." The American Biology Teacher, 13:149-57; November 1951.

⁴⁴ North Central Association of Secondary Schools and Colleges, Commission on Secondary Schools. Statistical Summary of Data from Annual Reports (Form A-2) 1951. 10 p. (Mimeographed)

teaching of science to date is the Riddle study.⁴⁵ Condition of buildings, science rooms and of equipment are listed in this survey and differences as among cities, towns, and rural areas are tabulated. Conditions as determined in various sections of the nation also are classified. While the Riddle study covered only the teaching of biology, it has significance in any general study of the teaching of sciences in the high schools of the nation. It is similar to the preceding study initiated by the Office of Education in being nation-wide in coverage and in being concerned solely with the teaching of biology.

While not concerned chiefly with the condition of the laboratory or its equipment, Anderson⁴⁶ nevertheless investigated such conditions as a preliminary part of his survey. Although the results of his survey in 56 Minnesota schools showed that many items were needed in the laboratories under investigation, yet no claim of representativeness can be made for his sampling. He did, however, find that only seven per cent of the biology teachers reported biological supplies as being excellent, while 23 per cent said their supplies were poor. In chemistry, however, only five per cent reported poor supplies while 49 per cent reported excellent to this question. Again, direct comparison may be made with conditions

⁴⁵

Oscar Riddle, et al., op. cit. Chapter IV.

⁴⁶

Kenneth Anderson, op. cit.

reported in this study.

In order to supplement and enrich the work of the science course, many teachers have turned to free and low-cost teaching aids, particularly those sponsored by business, industry, and federal and state governments. While much of this material cannot be placed in the category of supplies and equipment, yet much of it truly is classed as equipment or apparatus.

Two studies of the use of such materials have been given wide circulation. The first is that of the National Science Teachers Association⁴⁷ and the second is that written by Sinclair.⁴⁸ The NSTA report was concerned chiefly with determining the general criteria or bases for usefulness of the sponsored aids. Sinclair was concerned with the problems relative to getting desirable sponsored aids into the schoolrooms and ensuring that they would be used in sound educational situations. The present study queried science teachers concerning the use of such aids.

In a study of laboratory facilities and procedures for chemistry in the white high schools of North Carolina, Reynolds⁴⁹ discovered that conditions were far from good as they concerned equipment and supplies. While this study has probably been outdated by the great

⁴⁷

National Science Teachers Association, Advisory Council on Industry-Science Teaching Relations. How Science Teachers Use Business-Sponsored Teaching Aids. Washington, D. C.: THE ASSOCIATION, 1950. 35 p.

⁴⁸

Thomas J. Sinclair, A Report About Business Sponsored Teaching Aids. F. A. Owen Publishing Co., Dansville, New York. 1950.

⁴⁹

William Nathan Reynolds, "Laboratory Facilities and Procedures for Chemistry in the High Schools of North Carolina." Science Education, 25:89-93; February 1941.

progress made in recent years in the State of North Carolina, the findings may still have some significance. Certain findings were as follows:

In comparison with some other states the value of our laboratory equipment for chemistry is rather low. In 77 cases the value ranged from \$20.00 to \$510.00 with a median of \$237.50. It is encouraging that 33 schools have enough apparatus for individual experiments, but there are 39 with only enough for class demonstration.... only 56 per cent of the teachers feel that the supply of chemicals on hand is adequate for their apparatus.... The median amount spent per year for laboratory in 93 of the 111 schools is \$49.00 which is hardly enough to supply equipment for demonstration by the teacher.... The expenditures ranged from \$8.00 to \$375.00.

This study has significance insofar as the amount spent per year in the laboratories compares with similar amounts reported by Ohio's schools.

Studies Dealing With Teaching Effectiveness and Competence

Much has been written concerning the effectiveness of teaching. At different times investigators have attempted to approach this subject from many different angles. Some have taken the teacher's own judgment concerning competence, others have investigated the subject by referring to principals or other supervisory personnel, some have attempted to use the judgment of visiting experts, some have attempted to use pupil judgment, and others have tried to judge effectiveness and competence by using one form or another of evaluation.

This interest in teaching effectiveness has been marked by the use of a great number of different types of rating scale. Some teachers have attempted to judge their effectiveness by direct reference to their pupils through the use of a device similar to that published by Eidsmoe.⁵⁰ This device was used in the present study in obtaining evidence concerning some of the "forty teachers."⁵¹

Over the past thirty-year period, many investigators have attempted to answer questions which relate to effectiveness of various methods of instruction as well as the effectiveness of certain teachers. Particularly in teaching the sciences, the scientific movement in education brought forth many studies concerning the relative effectiveness of the laboratory method as opposed to the lecture-demonstration -- the effectiveness of moving pictures as a means of instruction as compared with use of still pictures -- the effectiveness of different types of drawing techniques, etc. Many of these studies are to be found in the literature, several of them excellently briefed in the Curtis Digests.⁵²

Without including as a portion of this report the numerous studies which have dealt particularly with method and the evidences

50

Russell M. Eidsmoe, A Pupils Rating Scale of an Instructor, Morningside College, Sioux City, Iowa.

51

See sample rating sheet in appendix.

52

Francis D. Curtis, A Digest of Investigations in the Teaching of Science. Philadelphia: P. Blakiston. Second Digest of Investigations in the Teaching of Science, Philadelphia: P. Blakiston. A Third Digest of Investigations in the Teaching of Science.

of superiority in effectiveness of one method over another, reference is made to an excellent source of such materials. Mallinson⁵³ has performed an excellent service for students of science education by compiling a comprehensive summary of these studies, including some of the older ones which still have significance as well as the newer ones. Mallinson's report⁵⁴ summarizes these studies under the general topic, "Research Studies Concerned Chiefly with Problems of Learning," and the investigator will find a summary of these studies under the sub-headings as follows:

Do scientific principles, scientific attitudes, and skills of the scientific method represent feasible objectives in science teaching?

What is, or are, the most effective method, or methods, for teaching science?

What evidence is available concerning the relative effectiveness of the lecture-demonstration and of the individual method for performing laboratory exercises?

What are the relative merits of the different drawing techniques for use with laboratory reports?

Is the time devoted to keeping notebooks for science justified?

Of what value are audio-visual aids for teaching science at the secondary-school level?

Do courses in science have any transfer value for later courses?

⁵³

George G. Mallinson, "The Implications of Recent Research in the Teaching of Science at the Secondary-School Level." The Journal of Educational Research, 321-342.

⁵⁴

George G. Mallinson, op. cit., p. 327.

Another such summary of studies is that of Cunningham⁵⁵ which is of interest to the careful student who desires to review the literature concerned with one aspect of the problem of effectiveness of method. Cunningham has done in this one area what Mallinson has done on a larger scale, with the exception that the former has probably given each study treated a little more attention than has the latter, since he was dealing with only one phase of the topic.

Mallinson and Sams⁵⁶ have studied one phase of teacher competence in a recent investigation. Assuming that knowledge of subject matter is a requisite for effective teaching, these investigators attempted, by using an evaluating device, to determine the relative amounts of knowledge of subject matter in the various sciences which was possessed by various student teachers in a number of teacher training institutions in mid-western states.

Mallinson's and Sam's note that earlier studies had indicated certain things to be true, as follows:

1. Student teachers (in science) in general seem better prepared academically in biology than in physics, chemistry, or earth science, although the differences may not be statistically significant.

55

Harry A. Cunningham, "Lecture Demonstration versus Individual Laboratory Method in Science Teaching: A Summary." Science Education, 30:70-82; March 1946.

56

George G. Mallinson and Conway C. Sams, "An Investigation of the Subject Matter Competence of Student Teachers in Science." School Science and Mathematics, 51:461-9; June 1951.

2. Student teachers in science are usually significantly better prepared in one field of science than in the others. However, the field varies with the student teacher, hence the training in the various sciences seem poorly balanced.
3. Student teachers of science when compared with high school pupils (who are majors in science) on tests in high school science score significantly lower on essay-type questions than do the high school pupils. They obtain better scores on short-answer questions than do high school pupils, but their superiority is not consistently significant.

Using these three statements as a background, the purpose of the study was to determine evidence concerning two questions:

(1) Is there any relationship between the number of semester hours in college science acquired by a student teacher in science and his knowledge of science subject matter? And (2) Is there a number of semester hours in college science that may be desirable in order that a student teacher in science know as much science as his high school pupils:

By use of various tests and interpretation of scores in the light of number of semester hours of credit presented by the student teachers concerned, conclusions were drawn as follows:

1. In most cases, the introductory course in science is sufficient to bring the student teacher to a level of subject matter competence equal to his high school pupils.
2. Many semester hours of science are needed in order that student teachers answer essay questions as well as high school science majors do. (About twenty hours, in biology and chemistry, about thirty-four in physics).
3. In all fields except earth science, the relationship between knowledge in science and number of semester hours is significant.

The significance of this study for the present study is to be found in the investigation devoted to the formal training of the teacher. Remmers, Martin, and Elliott⁵⁷ have interested themselves in the relationship between the student's ratings of the instructor and the grades received by the student. This study has certain significance to the present study because of its conclusion that there is reason to ascribe validity to student rating of instructors. Thereby some attention should be paid to the student rating of the effectiveness of the instructor and instruction.

Davis⁵⁸ has investigated size of classes and teaching load in the field of science. In general he found that pupils earned higher grades in smaller classes than in large. While grades are only one evidence, it might be claimed that such evidence as existed tended to show that more effective teaching was done in small classes than in large.

McGrath⁵⁹ in reporting experiences with using teacher-pupil planning at Boulder, Colorado, noted that while there are pitfalls to be avoided, the final result of such work can be very effective

⁵⁷

Henry Herman Remmers, F. O. Martin, and D. N. Elliott, Are Students Ratings of Instructors Related to Their Grades? (unpublished study.) Purdue University, 1949.

⁵⁸

Calvin O. Davis, "The Size of Classes and the Teaching Load," School Review, 31:412-429; June 1923.

⁵⁹

D. C. McGrath, "Some Experiences with Teacher-Pupil Planning of Laboratory Work in Chemistry." School Science and Mathematics, 44:793-7; December 1944.

teaching. Nicholson⁶⁰ attempted to answer the question, "What is a good teacher?" by listing sixteen things which a good teacher must do and be. He sees a good teacher as one possessed of a pleasant personality, with understanding and appreciation of student shortcomings; one who has understanding and appreciation of the pitfalls and stumbling blocks in the learning process. While the picture which Nicholson paints of the good teacher is perhaps to be viewed as that of an ideal, yet the fact remains that not all teachers whom individuals have regarded as being good measure up to all of Nicholson's points. Administrators must attempt to have effective teaching performed by teachers who may not compare favorably with the sixteen-point ideal envisioned by this writer. Nicholson's report was used in attempting to arrive at the "factors of effectiveness."

Sutton⁶¹ has attacked the other facet of this problem and has attempted to determine why teachers fail in their attempts to teach science. In investigating this problem he went to fifty principals and administrators and to a like number of science teachers. The most frequent administrative answers included the following:

⁶⁰

Douglas G. Nicholson, "What is a Good Teacher?" School Science and Mathematics, 51:597-601; November 1951.

⁶¹

Traver C. Sutton, "Teacher Failure in Science Teaching." School Science and Mathematics, 44:549-53; June 1944.

1. A lack of breadth of science understanding.
2. Over-emphasizing the branch of science currently being talked about.
3. Poor care of laboratories and equipment.
4. Not knowing how to direct and control laboratory work (and therefore perhaps substituting lecture for laboratory work).
5. Not interested in science, the school, or the community.

The science teachers themselves saw the following factors as being the most important factors in failure:

1. Inefficiency--not using the proper equipment at the proper time, or by using it unwisely.
2. Lack of proper training in the specific type of science work which the teacher on the job must perform. (Can't order chemicals, can't set up equipment, etc.)
3. Training not sufficiently practical. (Don't know how to conduct a typical class in a high school).
4. Introduction of generalized courses into the high school curriculum when the training has not been such as to fit the teacher for this work.
5. Too intense specialization at college level.
6. Too much time devoted to record keeping and other non-teaching work, thus causing the teacher to be unable to devote the proper time and energy to teaching.

It may be noted that certain of these causes as stated by both administrators and teachers involve the preparation period of the prospective teacher. If the teacher fails or is incompetent because he does not know how or where to order equipment, how to conduct a class, how to set up apparatus, how to care for laboratories and equipment, then the teacher training institution must carry much of the blame. Conversely, if the lack of these abilities causes failure of the teacher, it may safely be assumed that their possession in high degree would render a teacher more effective.

Thus any significance which this study has for the present study depends upon our analysis of the study in terms of adequacy of the sample and of the expertness of the individuals participating in it. This study also was used in developing the factors of effectiveness.

The effect of the school administration on the effectiveness of teaching is studied somewhat in the McCook, Nebraska case⁶². Doll⁶³ has studied the attitude of high school pupils toward various types of teaching procedures without explicitly carrying his report into the area of teaching effectiveness. Sister Mary Elvira⁶⁴ has used a similar approach in studying the opinion of students on teaching procedure.

McDaid⁶⁵ and Cole⁶⁶ investigated a subject which may have

⁶² McCook, Nebraska, "Report of an Investigation, McCook, Nebraska: Administration in a Small Community." Washington, D.C.: National Committee on Defense of Democracy Through Education (Commission of the NEA), 1947, 28 p.

⁶³ Ronald C. Doll, "High School Pupils Attitudes Toward Teaching Procedures." School Review, 55:222-7; April 1947.

⁶⁴ Sister Mary Elvira, "Student Opinion on Methods of Teaching," Educational Administration and Supervision, 32:74-66; February 1946.

⁶⁵ Elmer W. McDaid and others, "What is Your Teacher's Work Week?" School Executive, 66:41; July 1947.

⁶⁶ Thomas R. Cole, "Measuring Teachers Load in Secondary School Subjects." American School Board Journal, 115:31-32; December 1947.

some relation to teaching effectiveness, namely the work week and teacher load of secondary teachers including science teachers.

The Review of Educational Research⁶⁷ has taken special cognizance of the problem of teaching effectiveness and teaching success by devoting a section to this topic. The introduction to this topic begins:

Research in the measurement and prediction of teaching success has been characterized by widespread interest during the three-year period covered by this review. Even a cursory examination of the research completed during this period reveals certain unmistakable trends: (a) There were many more systematic studies employing refined research techniques than have appeared during earlier periods of research; (b) the subject was of interest to psychologists as well as educators; (c) new aspects of the subject, such as personality, adjustment, and teacher-pupil relations, became matters of special concern; (d) interest continued in the selection of teachers and the prediction of teaching efficiency; and (e) the application of evaluative techniques to merit pay schedules for teachers attracted considerable attention.

The relation of teacher personality and adjustment to teaching efficiency was a subject of special concern to several investigators. In one of these, Symonds offered a summary of thirteen papers on teacher adjustment published by the author since 1941. Barker collected data relative to fourteen phases of life adjustment; seven involved life adjustments and seven concerned work adjustments. The correlation between teaching efficiency and life adjustments varied from .08 to .35 and between efficiency and work adjustments from .36 to .58. Ash discovered a significant relationship between teacher adjustment and pupil adjustment.

Witty found from an analysis of approximately 12,00 letters from school children that democratic attitudes, kindness, considerateness, patience, and wide interests were thought by the writers to be of great importance in effective teaching.

⁶⁷

Review of Educational Research, 19: June 1949. Pp. 185-90.

Extensive studies of teacher-pupil relationships were conducted by Anderson and Brewer. They were particularly concerned with the teacher's dominative and socially integrative behavior in the classroom. Their data seem to indicate that certain behavior patterns and personality characteristics in the teacher persist from year to year and that the children's behavior tends to change as they are instructed in successive years by different teachers.

Cook and Leeds were particularly concerned with the teacher's personality and its bearing upon teacher-pupil relationships. They found that the teacher's attitude toward pupils, and the pupils' attitude toward teachers were significantly related. ($r = .46$). They also found that pupils' rating of teachers correlated to the extent of .39 with principal's ratings and .33 with experts' ratings of teachers.⁶⁸

Warning administrators that there are certain dangers in attempting to appraise the competence and efficiency of teachers, Raths⁶⁹ listed certain categories of teacher qualities. The United States President's Commission on Higher Education suggested certain

⁶⁸

The studies referred to in the quotation are as follows:

Harold H. Anderson and Joseph E. Brewer, Studies of Teachers' Classroom Personalities, II: Effects of Teachers' Dominative and Integrative Contacts on Children's Behavior. Applied Psychology Monograph No. 8. Stanford University Press. June 1946. 128 p.

Harold H. Anderson, Joseph E. Brewer and Mary Frances Reed, Studies of Teachers' Classroom Personalities III: Follow-up Studies of the Effects of Dominative and Integrative Contacts on Children's Behavior. Applied Psychology Monograph No. 11. Stanford University Press. December 1946. 156 p.

F. Elton Ash, "The Effect of Teacher Adjustment Upon Pupil Adjustment." Doctoral Dissertations, Abstracts and References (1940-41). Iowa City: State University of Iowa, 1944. Pp. 76-79.

M. Elizabeth Barker, "Personality Adjustments of Teachers Related to Efficiency in Teaching." New York: Teachers College, Columbia University. 1946. 97 p.

M. Elizabeth Barker, "Summary of the Relation of Personality Adjustments of Teachers to their Efficiency in Teaching." Journal of Educational Research, 41:664-75; May 1948.

Percival M. Symonds, "Personality of the Teacher." Journal of Educational Research, 40:652-61; May 1947.

Paul A. Witty, "Analysis of the Personality Traits of the Effective Teachers." Journal of Educational Research, 40:662-71; May, 1947.

Walter W. Cook and Carroll H. Leeds, "Measuring the Teaching Personality." Educational and Psychological Measurements, 7:399-410 May 7, 1947.

⁶⁹ Louis Raths, "Dangers of Appraising Teacher Efficiency." School Executive, 67:55-6; April 1948.

qualities for those who staff higher educational institutions. While there was no attempt made to develop a check-sheet for measuring competence according to these qualities, yet they could well form the basis for such an evaluation device. Because these qualities as given could be adapted to fit a high school situation, they have been included as follows:

1. Sound scholarship.
2. Professional competence.
3. A clear concept of the role of higher education in society.
4. Broad humanistic understanding.
5. Lively curiosity.
6. A sincere interest in research.
7. Insight into motivation.
8. A sympathetic, intelligence understanding of young people.⁷⁰

Barr⁷¹ has given an extensive review of many of the articles having to do with the relationship of various teacher qualities to efficiency.

Certain investigators have approached the problem of teacher competence by way of the improved certification requirement approach.

⁷⁰

The Report of the United States President's Commission on Higher Education." "Staffing Higher Education." Washington, D. C.: Superintendent of Documents, GPO, 1947. 63 p.

⁷¹

Arvil S. Barr and others. "The Measurement and Prediction of Teaching Efficiency: A Summary of Investigations." Journal of Experimental Education, 16:1-81; June 1948.

Among these are Bowers⁷², Cooper⁷³, Coyle⁷⁴, Frazier⁷⁵, Knight⁷⁶, and Wright.⁷⁷

In a further section of this study, an attempt has been made to show that certain individuals believe that there is a relation between the place of the teacher in the community and his success as a teacher. The place of the teacher in the community includes his participation in community affairs as well as any restriction which are placed on him by the community and his social status in the community. Certain studies have been made concerning the latter two phases of the problem. Crowder⁷⁸, for example, found

⁷²

Harold J. Bowers, "Round the Mulberry Bush." Educational Research Bulletin, 25:64-6; March 1946.

⁷³

Hermann Cooper, "Role of Certification in Getting Better Teachers." School Management, 15:500; May 1946.

⁷⁴

Irvin F. Coyle, "Teachers Certificates." School and Community. 34:116-7; March 1948.

⁷⁵

Benjamin W. Frazier, "Renewal of Progress in Teacher Certification." School Life, 30:18-21; April 1948.

⁷⁶

Edgar W. Knight, "Intelligent Teacher Certification." School Management, 15:422; April 1946.

⁷⁷

Grace S. Wright, "Teacher Improvements, Policies, and Practices." School Life, 30:21-4; May 1948.

⁷⁸

Farnsworth Crowder, "Educational Strait Jackets." Survey Graphic, 36:617-9; November 1947.

that teachers felt that they were in a sense second-class members of the community, feeling themselves watched and restricted, often at the expense of their creativity. Other writers, Mead⁷⁹ and Kaplan⁸⁰ included, believe that the situation described by Crowder is being changed somewhat. This present study offers some indication concerning what the science teachers of Ohio think of their own status and place in the community. Lichliter⁸¹ investigated the obligations and restrictions placed on women teachers. She included in her study a review of some of the community activities in which women teachers were required or expected to take part.

Because the relations of teachers with their supervisors may be an area which is a contributing factor in the competence and efficiency of teachers, the duty of the NEA Research Division⁸² has pertinence for this survey.

The preceding studies (60-82) were used in developing the tentative list of factors of effectiveness.

79

Margaret Mead, "Teachers Place in American Society." American Association of University Women's Journal, 40:3-5; October 1946.

80 Louis Kaplan, "New Horizons in Teacher-Community Relationship." Journal of Educational Sociology, 21:417-27; March 1948.

81 Mary Lichliter, "Social Obligations and Restrictions Placed on Women Teachers." School Review, 54:14-23; June 1946.

82 NEA Research Division, "The Teacher Looks at Personnel Administration." Research Bulletin, 23:95-147; December 1945.

In studying teaching of biology and chemistry in 56 Minnesota high schools, Anderson⁸³ found that according to the results achieved on a test battery, pupils achieved more (hence teachers were apparently more effective) if (in the case of Biology):

1. The teacher was in the upper one-fourth in terms of college science earned by the teacher.
2. The teacher graduated from a private college, rather than from a university or teachers college.
3. The teacher had a Master's degree.

Anderson found that in his survey the following factors among others did not appear to have significance for pupil achievement (in the teaching of biology): sex of the teacher, size of the school, number of preparations of the teacher, quarter hours of biology earned by the teacher (although total science preparation seemed significant), number of years of experience of the teacher, the teachers' knowledge of the scientific method. In general, Anderson's results in chemistry paralleled his results in biology, except that in chemistry there were a number of factors which, while having some difference one way or another, were not of sufficient value to have statistical significance.

Cahoon⁸⁴ has suggested that programs for teacher education be devised which look toward competency rather than credit hours.

⁸³

Kenneth E. Anderson, The Relative Achievement of the Objectives of Secondary School Science in a Representative Sampling of Fifty-six Minnesota High Schools. Doctoral dissertation. Minneapolis: University of Minnesota, 1949. 288 p. (Typewritten)

⁸⁴ G. P. Cahoon, "Competency in Science Teaching--Not Credit Hours." Science Education, 27:1-6; February 1943.

He envisioned a five-point program looking toward training teachers in fashion such that greater teacher competency might result. He suggested programs which are stated as follows:

1. Setting up factors in teaching competency for all teachers.
2. Devising ways for getting evidence of the various factors in competency.
3. Providing appropriate experiences for prospective teachers.
4. Setting hurdles at various stages.
5. Determining phases, evidences of and experiences for competency in specific areas (as science).

Quite a bit of work in science education at The Ohio State University within the nine or ten years prior to this present study has been in an endeavor to implement the five-point program suggested in the Cahoon report.

In a more recent survey embracing chemistry teachers in several midwestern and eastern states, Anderson⁸⁵ obtained some results which differed from those previously reported in his Minnesota study. While the study was not apparently so carefully performed as was the earlier study, yet there were certain interesting results. The study determined that students achieved significantly more in chemistry (on a particular series of tests) providing: they were enrolled in large schools (conflicted with Minnesot findings) the teacher's load was in the lowest quarter of the distribution, the teacher was in the upper quarter in terms of number of college hours

⁸⁵ Kenneth E. Anderson, "A Study of Achievement in High School Chemistry in Several Eastern and Midwestern States." Science Education, 34:168-76; April 1950.

of science and of chemistry taken, and class size was in the lower quarter of the distribution (this last item also conflicted with the data from the Minnesota study). While there were other findings in this as well as in the earlier study, these seem to have more significance for this report than do those which have been omitted.

In a very searching inquiry into the extra-contractual income of Wisconsin teachers, Stuart Anderson⁸⁶ emerged with almost two hundred separate findings, several of which bear directly on teacher competence, and many of which bear on the status of teachers. This study was not confined to science teachers, but was developed from answers to questionnaires sent to practically all of the public high school teachers in the state. Of the 7363 inquiries, 3620 completed forms were returned in usable condition, so that the sampling was at least somewhat representative.

Additionally, the sample was found to be representative with regard to the number of men teachers and the number of women returning it.

The findings were classified under headings as follows: professional status, personal data, teaching position, extra-contractual income. While only a brief notation has been made of the Anderson findings, many of them do have certain significance for this report. He found, for example, that sixty per cent of the Wisconsin respondents had some extra-contractual income, most of

⁸⁶ Stuart A. Anderson, "A Study of the Professional Personnel of Wisconsin Secondary Schools with Special Reference to Extra-Contractual Income." Journal of Experimental Education, 18:92-200; September 1948.

whom earned at least a part of this money while teaching. Further, he found that a fairly large majority of these people believed that their outside work was of help to them in their regular teaching work. Of particular significance for the matter of teacher-pupil rapport, over 78 per cent of those working felt that their outside work enabled them to get along more readily with people.

Particularly significant for this study, in addition to the figures given concerning age, experience, schooling, highest degree held, recency of schooling, length of time in position, was the finding that, "A summary of the rank orders of 15 selected professional, position, and personal factors revealed that the teacher with extra-income ranked above the group without extra-contractual earnings." There may be some who wish to quarrel with Anderson's selection of the 15 items which he used for comparison purposes, but they seem to this investigator somewhat representative.

One of his recommendations also seems somewhat pertinent to this study. It is as follows: "Teachers periodically should engage in suitable work experience, on a voluntary basis, at an occupation other than teaching, in order that they may gain a better understanding of the community and its economic life."

Smith⁸⁷ has summarized much of the writing concerning teacher competency in the following expression:

87

Ida Townsend Smith, "My Ideal Teacher." Science Education, 33:122-3; March 1949.

Granting that the person chosen for teaching is a "fine" person, what further may we ask? The second criterion may be called "competency"....To be worth ofsupport, the teacher must be a competent "practitioner" of those skills demanded in the classroom. He must understand the function of today's schools. He must understand and respect child growth and development. He must be skillful in leading educative experiences. He must be a master of the skills needed to build a modern curriculum. This would certainly involve scholarship, a knowledge of resources, an awareness of opportunities, and a sense of responsibility. He must be creative himself and accept creativity in others. He must be able to apply democratic principles and procedures in his classroom situation.... But one might be able to do all this and yet not be a real teacher, for a real teacher must also be a professional person.

Much of the preceding thought has been used in preparation of the preliminary inquiry for the present study.

Studies Dealing With Science Offerings in High Schools

Because the present study has surveyed the science offerings in Ohio, an attempt has been made to review the significant studies of the past few years which concerned themselves with this topic. Probably the most complete study of this type is that included in Chapter V of the Biennial Survey of Education. This chapter, entitled Offerings and Enrollments in High School Subjects⁸⁸ gives a rather complete picture of the subject offerings in the high schools of the United States for the years 1948-49.

⁸⁸

United States Office of Education. Offerings and Enrollments in High School Subjects. Biennial Survey of Education in the United States, 1948-50, Chapter V. Washington, D. C.: Supt. of Documents, GPO. 1951. Pp. iii 118.

In addition to including statistical data concerning the leading subjects taught in the high schools of the nation, a list of uncommon subjects also is included. Thus quite a number of sciences are listed which are not found at all in the State of Ohio. On the other hand, the leading sciences nation-wide also are those which are prominent in Ohio.

In the field of biological sciences, the Riddle study⁸⁹ and that of Martin⁹⁰ appear to have some pertinence.

Basing his findings on statistical reports from 715 (or 3.15 per cent) of the nation's 23,947 high schools, Johnson⁹¹ released information based on the school year 1947-48 which coincided very closely insofar as science offerings are concerned with the biennial survey made a year later. Johnson included some information pertaining to the number of high schools offering certain sciences; information which was lacking in the biennial survey. Additionally, he included information relative to the trends as exemplified by comparison between his figures and those of an earlier (1922) survey. He obtained data concerning science teachers and concerning

⁸⁹

Oscar Riddle, op. cit., Section VI.

⁹⁰

Edgar Martin, op. cit.

⁹¹

Philip G. Johnson, The Teaching of Science in Public High Schools, Bulletin 1950, No. 9. Washington, D. C.: Supt. of Documents, GPO. 1950. 48 p.

the alternation of sciences within the schools which were not found in the biennial report.

The Review of Educational Research⁹² has summarized certain materials which seem to have pertinence for the present study as follows:

Not much evidence of a changing curriculum in high-school science emerged from that data collected and presented in the Office of Education report. However, a total of 135 of the 715 schools in the sample reported one or more science offerings in addition to standard courses in general science, biology, chemistry and physics. Most frequently reported were "applied" courses such as applied physics; next in order of frequency was physiology; then came courses in "related science." Also reported were offerings in physical science, earth science, plant science, and five other subjects. Johnson found that all courses offered in addition to the four standard courses could be classified in three groups: physical science, "broad science," and biological science. Of these, physical science was offered in the greatest number of schools -- 61 in all; 49 had "broad science" courses; and 25 had additional courses in biological science.

Laton and Powers were able to classify curriculum changes in the new schools with which they worked as of three kinds: the introduction of new interdepartmental courses, almost all of them centered in a study of the community; the development of new science courses; and changes in emphases within existing courses. They had no doubt as to the basic cause of these curriculum changes: the teachers themselves had changed as a result of their own study of communities, adolescents, and the persistent problems of people in the present world. Klohr investigated the effect on curriculum change of the resource unit, which may be described as suggestions for teaching about some broad area of experience, so organized as to serve as a source for ideas, material, and procedures for teachers planning their

work. Resource units were found to be effective agents of curriculum reorganization where used, but their use was not widespread.⁹³

As a summary to the studies which have been reviewed, a recent survey by Spore⁹⁴ may be used to conclude the matter. He found conditions in the United States to be about as follows in science education:

1. Enrollments are steadily increasing in science except in physics, which is dropping.
2. Not much change occurred in general science enrollments during the time of this survey.
3. There is strong indication of a rise in popularity of a course at senior high school level built on general science content.

⁹³ In the portion of the Review of Educational Research quoted, the following articles and studies were reported:

Philip G. Johnson, The Teaching of Science in Public High Schools, an Inquiry into Offerings, Enrollments, and Selected Teaching Conditions, 1947-48. U. S. Office of Education, Bulletin 1950, No. 9. Washington,

Philip G. Johnson, The Teaching of Science in Public High Schools, an Inquiry into Offerings, Enrollments, and Selected Teaching Conditions, 1947-48. U. S. Office of Education, Bulletin 1950, No. 9. Washington, D. C.: Government Printing Office, 1950. 48 p.

George W. Hallinon, "A Report to the National Association for Research in Science Teaching on the Activities for 1949-50 of the Co-operative Committee on the Teaching of Science and Mathematics of the American Association for the Advancement of Science." Science Education, 34:177-80; April 1950.

Anita D. Laton and S. Ralph Powers, New Directions in Science Teaching. New York: McGraw-Hill Book Co., 1949. 164 p.

Paul Robert Klohr, "A Study of the Role of the Resource Unit in the Curriculum Reorganization of Selected Secondary Schools." Abstracts of Doctoral Dissertations, No. 57, 1947-48. Columbus: The Ohio State University, 1949. p. 111-60.

⁹⁴ Leroy Spore, An Investigation of the Trends in Science Education in the Secondary Schools of the United States. Unpublished study. Claremont, California: Claremont Graduate School. July 1949.

4. Biology is still expanding in offerings.
5. Chemistry and physics are meeting certain demands by the use of applied courses in these two sciences.
6. The movement toward the "broad fields" approach is still in the struggling stage.
7. Teachers indicated that they wished to direct their teaching toward helping youth to live in a world in which the ways of life are based upon interpretations derived from science.

The studies which have been reviewed or quoted have special significance for this study because of the fact that by using them as bases, the present survey can be made to assume (at least partially) a modicum of utility as a comparative study. A comparison of the findings of these studies with the present one will show certain trends which have been observed in greater or lesser degree through the past dozen years by other investigators.

Studies Dealing with Philosophies of Science Teachers

Studies dealing with the philosophies of teachers in general seem not to be lacking in the field of educational research, and additionally, much has been written which is in the field of opinion rather than research. There are few studies, however, which deal exclusively with the subject of the philosophy of the science teacher.

One of the most recent of these is that conducted by Abbas⁹⁵.

In his survey he attempted the following:

1. To classify the main philosophies of science teachers.
2. To use an instrument to analyze the theoretical and practical positions of science teachers according to their philosophies.
3. To provide science teachers with an instrument for seeing the relation between their beliefs and practices.
4. To determine prevailing philosophies and practices.
5. To detect the influence of certain factors on philosophy and practice (age, sex, years of experience, educational qualifications, major areas of interest, subjects taught, load, grade level, size of community, state).

Because his findings are of interest in the present study, they have been summarized as follows:

1. Of all of the science teachers included, 71.9 per cent accept and are likely to practice some kind of educational experimentalism.
2. Less than two per cent accept and less than one per cent practice educational laissez faire.
3. Nearly ten per cent of these teachers accept and are likely to practice authoritarianism.

⁹⁵ Ahmed A. Abbas, Classification and Analysis of Philosophies of Certain Science Teachers. Doctoral thesis. Greeley: Colorado State College of Education. 1949. (Typewritten)

4. About 12.5 per cent of these teachers practice authoritarianism, 8.5 per cent say they believe in it.
5. The sum of the number of science teachers who are indifferent to the three philosophies is greater than the sum of those accepting and practicing laissez faire and authoritarianism.
6. The teachers of Colorado were more likely to believe in and practice the philosophy of experimentalism than those of New York, California, and New Mexico.
7. Communities of 10,000 to 50,000 are more likely to see experimentalism in their science classrooms. Those of less than 1,000 are more likely to have authoritarianism than are communities larger.
8. All other science teachers are more likely to be experimentalism minded than are physics teachers.
9. The higher the educational qualifications of a teacher (excluding the doctor's degree) the more likely experimentalism is to appear.
10. Teachers who are carrying very heavy loads seem to be more indifferent than others.
11. Teachers with 30 or more years of experience tend to be more authoritarian than younger ones.
12. Teachers over the age of 59 are more likely to be more indifferent and less experimental in belief and

practice than are younger teachers.

13. Sex and grade level taught seem to have no influence on philosophy.

14. One-fifth of the science teachers are inconsistent in their beliefs and practices.

While the present study does not go into a detailed study of teacher philosophy, one question in the study related itself to the educational philosophy and objectives of the teachers concerned.

In this sense the preceding report has significance for this study.

Studies Dealing with the Objectives of Science Teaching

The literature of science education is filled with references to aims and objectives of science teaching. Much of this work is expository in nature, but some of it is material which has been supported by research.

Historically, one of the early attempts at developing objectives for education was that of the Commission on the Re-organization of Education, which in 1918 enunciated the famous Seven Cardinal Principles of Education⁹⁶. These seven principles have been used as a beginning point for untold numbers of articles and studies concerning philosophies, aims, and objectives of education from the

time of their formulation and statement. Their influence still looms large in the thinking of many students.

Implementing the cardinal principles insofar as science education was concerned was a second report which was the first authoritative report ever issued on the teaching of **secondary** school science in the United States. This report, issued by the Subcommittee on the Teaching of Science⁹⁷, among other items showed how science instruction could be made to contribute to the fulfillment of the seven cardinal principles. This report also had considerable effect on the emergence of a definite sequence of science courses in the high schools. In general, it was a timely report, much needed and rather widely accepted.

Another early report which was quite influential and is still quoted was that of a committee of the American Association for the Advancement of Science⁹⁸. Much of the organizational work of American science teachers found its early impetus in the 1927 report of this committee.

Probably the most influential report ever released concerning science teaching was that of the Thirty-First Yearbook committee⁹⁹

⁹⁷ Commission on the Reorganization of Secondary Education. "Report of Subcommittee on the Teaching of Science." U. S. Bureau of Education Bulletin No. 26. Washington, D. C.: GPO. 1920.

⁹⁸ American Association for the Advancement of Science, "Committee Report on the Place of Science in Education." School Science and Mathematics, 28: June 1928.

⁹⁹ Program for Teaching Science. Thirty-first Yearbook of the National Society for the Study of Education, Part I. Bloomington, Illinois: Public School Publishing Co., 1932.

This report has profoundly influenced the thinking of teachers and investigators over the period of the past two decades. Written by the men who have become the deans of science teachers in the United States, much of the thinking of this committee is in evidence. Built about the "large concept" idea, curricular reorganization suggested by this volume was based on objectives which are still widely accepted.

While they are variously stated in the yearbook itself, and are paraphrased elsewhere throughout the literature, the major objectives of science teaching as discussed by the committee seem to include (1) to develop in students a functional understanding of important scientific principles; (2) to develop in the students the scientific attitudes and interests; (3) to give training in the skills of the scientific method. Beyond these larger objectives, the committee suggested that there were many objectives for the teacher of science, and included a list of statements from which some of these specific objectives might be developed.¹⁰⁰

While only a part of the importance of the Thirty-first Yearbook was due to its enunciation of the "large concept" idea, yet this is

At about the same time that the Thirty-first Yearbook was published, another important publication, the result of Beauchamp's

100

Thirty-first Yearbook, op. cit., p. 50.

study¹⁰¹ was being prepared in the United States Office of Education. Based on study of quite a number of courses of study in twenty-six states of the union, the chief importance of the Beauchamp study for the present investigation is its inclusion of a tabular analysis of the objectives listed in courses of study in science. He found 27 different objectives listed under a number of main headings. He also determined quite a number of sub-objectives listed under the 27 different objectives requiring separate listing. The objectives were placed under the six main headings as follows: Knowledge; Exploration or Orientation; Abilities, Attitudes; Ideals and Habits; and Interests. Beauchamp further determined the number of courses of study in the four major divisions of high school science which mentioned the individual objectives. A swift perusal of the objectives found by the investigator in 1932 shows the influence of the seven cardinal principles.

The thinking of the Progressive Education Association was well exemplified in a publication Science in General Education¹⁰² prepared by one of its committees. Going further than had the Thirty-first Yearbook committee, this publication called for science in the high schools to be based on broad areas of living, including personal living, immediate personal social relationships, social-

¹⁰¹ Wilbur Lee Beauchamp, Instruction in Science. National Survey of Secondary Education Bulletin 1932, Monograph No. 22. U.S. Department of the Interior, Office of Education. Washington, D.C.: GPO, 1932. Pp. ii 63.

¹⁰² Progressive Education Association, Commission on Secondary Curriculum, Science in General Education. New York: D. Appleton-Century Co. 1938, Pp. xii 591.

civic relationships, economic relationships, and the disposition to use reflective thinking in solving problems.

In more recent years, the Forty-Sixth Yearbook¹⁰³ has re-examined the problem of determining objectives in science education and has developed the following list¹⁰⁴.

1. Opportunities for growth in the functional understanding of facts.
2. Opportunity for development of functional concepts.
3. Opportunity for growth in the functional understanding of principles.
4. Opportunity for growth in the basic instrumental skills.
5. Opportunity for growth in the development of scientific attitudes.
6. Opportunity for growth of skill in the elements of the scientific method.
7. Opportunity for growth in the development of appreciations.
8. Opportunity for growth in the development of interests.

In the light of many studies which have been made, Anderson¹⁰⁵

¹⁰³ National Society for the Study of Education, Science Education in the American Schools, Part I. Chicago: University of Chicago Press. 1947.

¹⁰⁴ Ibid., p. 142.

¹⁰⁵ Kenneth E. Anderson, Doctoral Dissertation, op. cit.

has developed a set of objectives which he used in connection with his doctoral study. These include:

1. The acquisition of factual information in science.
2. The understanding of the "big ideas" or principles in science.
3. The understanding and use of the scientific method.
4. The acquisition of scientific attitudes.

Heiss, Obourn, and Hoffman¹⁰⁶ have developed a group of "Goals in learning science" which consist of the following:

1. The acquisition of functional understandings.
2. The acquisition of a fund of appreciations.
3. The acquisition of certain attitudes or mind-sets.
4. A method of attack on problems (problem solving).

The Co-operative Study of Secondary School Standards has developed¹⁰⁷ a group of "guiding principles" as a basis for its attempt at developing a system of evaluation for secondary schools. These guiding principles are as follows:

1. The understanding and application of major scientific principles.
2. The development of competence in the use of the scientific method.

¹⁰⁶

Elwood D. Heiss, Ellsworth S. Obourn, Charles W. Hoffman, Modern Science Teaching. New York: The Macmillan Co. 1950. 462 p.

¹⁰⁷

Co-operative Study of Secondary School Standards, Evaluative Criteria 1950 Edition, Washington, D. C.: Co-operative Study of Secondary School Standards. 1950. pp. iii 305.

3. The development of desirable attitudes, interests, and appreciations related to science and its applications.¹⁰⁸

Particularly valuable for the purposes of the present study are the lists of objectives which Anderson¹⁰⁹ obtained from the teachers themselves. In the present study, an attempt has been made to have the teachers express themselves in terms of what they were trying to accomplish in their science teaching. Anderson has made an attempt of the same type with teachers of biology and chemistry. Because of the similarity of the two studies at this point, a listing of those most frequently determined by Anderson has been included. There are, for teachers of biology:

1. To give pupils a true understanding of the interdependence of life-balance of nature.
2. To provide a basis for healthful living.
3. To acquaint pupils with the fundamental knowledge of plant and animal life.
4. To develop better citizens.
5. To understand the physiology and anatomy of the human body.
6. To develop an appreciation of nature and one's own environment.

¹⁰⁸ Ibid., p. 177.

¹⁰⁹ Kenneth E. Anderson, doctoral thesis, op. cit.

7. To understand and apply the basic principles of biology.
8. To be able to apply biological principles to everyday living.
9. To acquire the ability to use the scientific method in the solution of problems.

Teachers of chemistry saw the following objectives in their teaching:

1. To give pupils an understanding of matter and its use in relation to everyday living.
2. Preparation for college.
3. To learn to use the scientific method.
4. To develop scientific attitudes.
5. To acquire a functional knowledge about food, clothing, and shelter.

In neither case is the listing of objectives complete. Anderson included only those which were mentioned with greatest frequency; for example there were forty-one separate objectives listed in chemistry, of which only five were listed with sufficient frequency to warrant their inclusion.

Noll¹¹⁰ has listed aims of science teaching some of which are, in effect, objectives. He has attempted to place some of these as position in junior or in senior high school. His aims are as

¹¹⁰ Victor H. Noll, The Teaching of Science in the Elementary and Secondary School. New York: Longmans Green and Co. 1939.

follows:

1. Understanding of the nature and organization of the environment.
2. Attainment of health.
3. Acquisition of desirable habits of work and study.
4. Inculcation of habits of thinking that contribute to scientific attitudes.
5. Development of ability to use the scientific method.
6. Development of ability to do household tasks (repair, etc.)
7. Development of interest in science.
8. Opportunities for exploration.
9. Provision for vocational education.

A quite recent statement of objectives has been listed by Baker¹¹¹ for the consideration of scient teachers. This list includes:

1. Emphasizing the underlying facts, principles, and concepts that are related to living in the Atomic Age.
2. Alerting people to the hazards of human welfare that are resulting from shrinking natural resources.
3. Acquainting people with desirable health practices, procedures, and techniques in evaluating medical services.

¹¹¹ Arthur O. Baker, "Science in the Cleveland Public Schools," Science Education, 33:110-5; March 1949.

4. Finding opportunities to direct basic science content toward intergroup education.
5. Improving international relations.
6. Encouraging pupils to pursue science hobbies.
7. Training pupils in the "know how" for operating simple machines, gadgets, motors, and appliances related to everyday life.
8. Discovering and increasing the flow of science talented youth.

While there probably are many who would look upon the "gadgetry" of Baker's seventh point as being somewhat afield from a listing of major objectives of science teaching, and while there probably are others who would look upon the fifth objective of improving international relations as being far afield from the science room and somewhat visionary in its relationship to the average science teacher, yet these objectives have not been drawn hastily and do deserve particular attention. This list of objectives becomes particularly pertinent to the present study since it represents the avowed science objectives of the largest school system in the state under survey.

Some consideration has been given to the literature concerning philosophy and objectives because a portion of the present study approaches these areas. While no question was listed asking for a statement of philosophy or objectives as such, the final question

of the form sent to all Ohio science teachers did ask the question, "In a few words, if you will, please state what you are trying to accomplish in your science teaching." From the various answers to this question, much information was determined relative to the philosophies, aims, and objectives claimed by Ohio's secondary school science teachers.

Studies Dealing with the Place of Community Resources in Science Education

Certain movements in the secondary school during the past decade or so appear to have influenced greatly the attitude of school people toward the use of community resources. Of these, probably the one receiving the most popular acclaim is the concept of the community school. Another is the retreat from the single-textbook-lecture method of teaching which was attacked early by the activity school and more latterly by the progressive movement in education. Another factor, certainly, and one which has been at least somewhat effective is that of the emergency of commercial and industrial materials which have a greater or lesser place in education. Coupled with the production of commercially sponsored teaching aids, there has appeared a willingness on the part of business and industrial groups that the schools use their industries and commercial houses as laboratories, at least so far as visitation is concerned. "B.I.E." days have become common in the schools, and in many areas industries even have exerted mild pressure that

pupils in various classes make conducted tours through their plants, sometimes without much care for the tie-in with the total picture of education.

Teachers, however, must learn to accept these good offices and channel them into educationally sound and useful purposes, remembering that here is an opportunity which has not always been available, and that its utility depends on the vision of the teacher.

Not too many research studies have been concerned with the school's use of the community's resources in the field of secondary science, but there are some available which at least touch on the problem.

Bailey¹¹² made one of the few studies to be devoted primarily to the use of community resources in science teaching. He made the following discoveries:

1. Documentary materials, audio-visual materials, and field trips are the most used community resources by the Texas science teachers surveyed.
2. Science teachers seldom use resource visitors, interviews, and surveys.
3. Teachers of general science and biology use community resources more than do teachers of chemistry and physics.
4. Industrial plants, public utilities, water departments,

¹¹² Doyle E. Bailey, The Use of Community Resources by High School Science Teachers. Doctoral thesis. Greeley, Colorado: Colorado State College of Education. 1950. 88 pp. (Typewritten)

public health departments, and natural resource agencies are the community resources most frequently used by Texas science teachers.

5. The size of the community had little effect on the use of community resources in science teaching.
6. Three reasons cited by teachers as preventing their use of community resources were (1) rigid class schedules; (2) transportation troubles, and (3) lack of available resources.
7. Disfavor of the faculty members has a serious effect on amount and type of use of community resources.
8. School administration and community disfavor did not appear to be serious deterrents to use of community resources.
9. As a general thing, local community personnel appear to be very co-operative with teachers desiring to use community resources.

Nelson¹¹³ has reported an experiment in Illinois which embraced in-service education of teachers in science. In this effort, teachers were taken on visits to certain science-rich facilities such as factories. They compiled handbooks concerning these facilities and

¹¹³ Dale Elton Nelson, "Making Teachers Aware of the Science Teaching Resource in Their Community," Science Education, 35:69-71; March 1951.

included information valuable in serving as a general guide in organizing and taking field trips. Apparently these teachers also investigated the science-education possibilities of many other facilities in the community which they were unable to visit as a group and determined how these might be used with classes of high-school students.

Since most of the consideration which has been given to use of community resources is relatively recent, and since there have been in the past few years a number of books which have been devoted to developing the concept of the community school, it is likely that the present somewhat meager treatment of community resources and their use in the teaching of secondary science will change somewhat within the next few years.

Summary

While the preceding pages have presented quite a number of studies relating to the teaching of science in the secondary school, no attempt has been made to exhaust the field of printed research studies. Rather, an attempt has been made to include short reports of investigations which have considerable pertinence for the present study.

The interested student is referred to the bibliography for reference to a great number of other articles which have minor importance for the present thesis.

CHAPTER IV

FACTORS RELATED TO THE EFFECTIVENESS OF A LEARNING SITUATION IN SECONDARY SCIENCE

INTRODUCTION

After a fairly thorough survey of the literature related to effectiveness and competency in science teaching, a list of seventeen factors were compiled, each of which was presumably related to the effectiveness in a learning situation in secondary science. This final list was the end result of a number of earlier lists which had been studied carefully by a number of individuals each of whom had some interest in the progress of the study.

This final list was compiled in such fashion that each factor was separated from all other factors in the list, and each factor was aimed at the exposition of one facet and one facet alone in the learning situation. Complex factors were separated into their component factors as nearly as was possible.

By separation of the learning situation into a number of discrete factors which bear on the total picture, it was felt that there was greater possibility of arriving at situations which might be studied. It has been recognized that no learning situation ever can be analyzed to the extent that is presupposed by the type of listing proposed in this study; however, there is no reason to believe that considerable analysis cannot be made.

The final list of seventeen factors which were selected for study is as follows: Other factors being equal.

1. Effective learning is more likely to occur when the teacher has a broad background of knowledge in the particular science he is teaching as well as in the related scientific areas.
2. Effective learning is more likely to occur when the teacher has a functional knowledge of how children develop and how learning takes place.
3. Effective learning is more likely to occur if the teacher knows about, understands, and uses a variety of methods of instruction as opposed to the exclusive use of one or two methods.
4. Effective learning is more likely to occur when the teacher is living the life of a normal citizen in the community, exerting community leadership appropriate to his educational position.
5. Effective learning is more likely to occur in our society when the teacher has a well-thought-out and consistent philosophy of teaching and when the teaching practice is consistent with the stated philosophy.
6. Learning will proceed more effectively when the teacher is skilled in the use of classroom aids and devices, when he is familiar with, has accumulated, and uses teaching materials of various kinds, and when he knows about and uses sources of information beyond the single textbook.
7. Learning will proceed more effectively when the teacher has established rapport with the learners and when the learners believe that the teacher is well informed.
8. Learning will proceed more effectively when the major professional interest of the teacher and his major expenditures of time and energy are concerned with teaching and not with some other occupation.

9. Learning will proceed more effectively when there is rapport and mutual respect between the science teacher and his immediate supervisor.
10. Learning will be more effective if the teacher is not carrying an excessive load, either by reason of an excessive number of preparations, an excessive number of pupils per day, or an excessive extra-curricular or out-of-school series of responsibilities.
11. Learning will be more effective in a school which has a wide variety of science offerings than in one which has a very limited number of such offerings.
12. More effective learning is likely to occur when the program of the school is directed toward providing for the special needs of the youth of the community rather than when the program is not so directed.
13. More effective learning is likely to occur when the program of the school is directed toward providing for the general educational needs of youth than when the program is not so directed.
14. Learning will proceed more effectively when the learners and the teacher sense the direction of the teaching, when both participate in the planning, and when the learners see the fulfillment of their own aims implicit in the objectives of the course.
15. Learning will proceed more effectively if the amount and type of laboratory equipment needed to fulfill the aims of the work is present and in operating condition, and if the number and type of aids, devices, supplies and materials are at hand and in condition to be used.
16. Learning will proceed more effectively in a good physical environment than in a poor one.
17. Learning will be likely to be more effective when considerable attention is given to problem solving, development of critical thinking and scientific attitudes.

As has been noted earlier, the preceding list of statements was arrived at by rather careful study. After reference had been

made to the available literature concerning effectiveness in the teaching of science (see footnotes 60-83 inclusive in Chapter III), a tentative listing was made which included fourteen statements which the investigator believed to be probably true. This list of statements was refined further through discussion and conference with several interested and informed individuals.

It was determined, for example, that some of the statements as originally drafted were not clear, that some held within them a factor duality, and that others were of somewhat doubtful worth. While it is not possible to give credit to all who assisted in molding the changes in statement, yet over a period of some months, refinement occurred which gave a list of seventeen factors, each of which was believed to be of value in describing a good teaching or learning situation in science.

The seventeen statements were next submitted to a group of nine secondary science teachers, all of whom were individuals with considerable experience in the field, and all of whom were acquainted with the general purpose of this study. None had seen the list of statements previously, however. The criticisms of this group were embodied in a final draft of the statements which was prepared for mimeographing. As a result of the science teachers' review, no statements were changed in intent, but several were modified for the sake of clarity. All of the group of nine agreed with all of the statements as they finally were drafted.

The method just described was chosen as one which should give reasonably good results within the time limits imposed by the nature of the study. No other method at hand promised to produce a listing of "factors of effectiveness" which was likely to have greater validity than the method used and which still would not consume a greater amount of time than the limits usually imposed upon a study of this type.

Following the preparation of the mimeographed list of factors of effectiveness, it was decided to attempt to get reactions from individuals who were members of professional groups interested in teaching in general, and in the teaching of science in particular. Thus one group was chosen because its membership list contains the names of many if not most of the individuals in this nation who are engaged in the problems of research in science teaching. A second organization was chosen for inclusion because its members are almost all professional science teachers. A third and fourth organization were chosen because their members are those who are in rather direct positions of supervision over the work of the school including the work of the science teacher.

Thus the organizations whose members were represented in the opinionnaire devoted to factors of effectiveness were the National Association for Research in Science Teaching, the National Science Teachers Association, the American Association of School Administrators, and the National Association of Secondary School Principals.

The total membership of the NARST was polled, while with NSTA, a sampling of 250 members, all of whom had expressed interest in secondary science teaching were contacts. With the AASA and the NASSP, two members were selected at random for each of the forty-seven states of the Union aside from Ohio, and in Ohio every fourth individual listed was asked to reply to the opinionnaire. These membership lists were for the year 1951.

In each case, the individual contacted was asked to agree or to disagree with the statement as given, or to agree or disagree with qualifications or reservations. Space was given so that the individual responding might have room for comment.¹

Of a total of 791 questionnaires submitted, 528 were returned, for a percentage return of 66.75 per cent. Further data have been tabulated in Table I.

Reactions from the membership of the National Association for Research in Science Teaching were believed to have very great value for this study. The individuals represented in this group are interested chiefly in the professional preparation of science teachers, and almost all of them either are at present, or have been engaged directly in this work of teacher preparation. No other organization which exists in this nation has within it such a high concentration of those who furnish professional leadership

to the science teachers of the nation. Thus the investigator believed that the opinions of the membership of the NARST should have special value in this study. As professional people they are in their work ever alert to good science teaching, ever attempting to produce better science teachers.

Reactions from members of the National Science Teachers Association were obtained because the membership of this organization is chosen chiefly from the practicing science teachers of the country. By becoming members, science teachers display a certain degree of professionalism and of interest in their field. As such, responses from these individuals should be considered as of somewhat more worth than responses from an unselected group of science teachers.

The professional leaders of the school system were polled through making a sampling of membership from the AASA and the NASSP. These men are those who must see science teaching in its proper perspective if the school is to be effective. They are the men who daily must judge the effectiveness of their school and of the component parts.

It was felt that the four organizations selected consisted of individuals who, in the main, were interested and had a very considerable stake in teaching effectiveness. It was felt further that of the four, at least two included numbers of individuals who were deeply interested in and had a considerable stake in teaching effectiveness in secondary science.

Thus the method of validation outlined above was chosen because of a feeling that those who prepare science teachers, those who teach science, those who supervise the work of science teachers, and those who direct the total operation of school systems not only are interested in the effectiveness of science teaching, but also have the ability to make determinations with regard to the probable truth or falsity of a given condition as it bears on the effectiveness or lack of effectiveness of a total pattern.

The listing was weighted in favor of Ohio in two instances, those which involved the secondary school principals and the superintendents. This weighting was made because of the fact that application of the results was to be made to science teaching in the State of Ohio, hence, it was felt advisable to have a somewhat larger sampling of opinions from this state. Had there been wide differences of opinion as between principals and administrators in this state and in other states, further check would have been necessary. The larger sampling in Ohio was the best means which offered itself to see whether such difference of opinion did exist.

Table I indicates the number of opinionnaires submitted and the number and percent of returns from each group queried.

TABLE I

NUMBER OF QUESTIONNAIRES SUBMITTED, AND NUMBER AND PER CENT
OF REPLIES RECEIVED FROM VARIOUS GROUPS

Organization	Number Submitted	Number Returned	Per Cent Returned
National Association for Research in Science Teaching	161	106	65.84
National Science Teachers Association	250	163	65.20
American Association of School Adminis- trators (nation)	96	68	70.83
American Association of School Administrators (Ohio)	88	67	76.14
National Association of Secondary School Principals (nation)	96	49	51.04
National Association of Secondary School Principals (Ohio)	100	75	75.00
Totals	791	528	66.75

Tabulation of Replies

In general, the opinions expressed by members of NARST indicated that considerable thought had been given to the answers. Several respondents asked for additional copies of the paper, a few expressed rather general agreement but wondered concerning the purpose, and one person was in complete disagreement with the idea that opinions had any validity at all in such a matter. Quite a number of respondees quoted briefly from studies which had been made or were in progress, or quoted personal anecdotes which tended to show the validity of one point or another, or which tended to indicate need for minor revision in one or another item.

The sampling of the membership of NSTA was selected from a random group of 500 names submitted by the Association itself. The only qualification given by the investigator was that the individuals named have an expressed interest in secondary-school teaching. From the 500 names submitted, 250 were chosen for inclusion in this study by the simple expedient of taking alternate names.

In general, the results of the opinionnaire as submitted to the membership of NSTA agree with the results from NARST, although there were minor differences. A smaller number of qualifications were listed, even though there were a greater number of respondees. A smaller number of additional factors was suggested.

The reports from school administrators as represented by AASA and from secondary-school principals as represented by NASSP were roughly in agreement, and they agreed roughly with the responses from the membership of the two science teaching organizations.

Detailed results have been given as follows: The factor queried is listed, then following it, tabular results have been given. Following this tabulation, discussion of the factor and the various suggested qualifications have been added.

Factor 1. Other factors being equal, effective learning is more likely to occur when the teacher has a broad background of knowledge in the particular science he is teaching as well as in the related scientific areas.

TABLE II

RESPONSE TO FACTOR I

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	94	0	8
NSTA	153	2	6
AASA	128	1	4
NASSP	122	1	1
Total	497	4	19

NARST Responses

This first factor of effectiveness was viewed as valid by 94 of the 106 respondents as may be seen by reference to Table II. No one disagreed with the statement as it stood, but eight individuals wished to add to or to amend the statement, chiefly by making it somewhat more inclusive. Four individuals expressed no opinion. The qualifications which were desired by the respondents included the following:

1. "Would even extend this broad background beyond science background." (Stated in essence by four individuals).
2. "Would desire to say, 'Broad background in science.'"
3. "Especially a working knowledge, not just a theoretical knowledge."
4. "There is need for depth also."
5. "Provided he does not use this background in an attempt to impress."
6. "Provided he uses this background to illuminate his teaching and to present an integrated approach in the use of that background." (In essence stated by two individuals).
7. "I would desire to add, 'And an understanding of the significance of these backgrounds in a pattern of general education.'"
8. "Influenced by whether the background is theoretical or practical."

A few of the respondents appended more than one qualification, but it may be noted that in only two instances did more than one respondent voice identical qualifications. Qualifications three and eight are similar, but not quite identical in meaning.

NSTA Responses

Of the 163 respondents, a large majority (153) agreed with the proposition, while six agreed with qualification and two did not agree. Two did not answer.

The qualifications desired by those who wished to amend the original statement were as follows:

1. "Provided he doesn't inflict all of his knowledge on the students."
2. "If he is not so erudite as to fail to see the students' difficulties."
3. "If he is really interested in bringing this wealth of knowledge to the pupils."
4. "Provided he is not over the pupils' heads." (Two voiced this opinion.)
5. "Provided that it is a meaningful, functional knowledge, not just book learning."

Response from AASA

Of all administrators responding, 128 agreed with the thesis of factor 1 concerning the science background of the teacher. Of these, 66 were from Ohio and 62 from the remainder of the nation. One Ohioan wished to qualify his answer, as did three others. One non-Ohioan disagreed with the thesis of the factor. The qualifications were as follows:

1. "Breadth of knowledge need be no greater than needed to answer an occasional question." (Ohio)

2. "If the teacher uses this background in guiding pupils in experiences, solving and evaluating problems growing out of their social-scientific world."
3. "If some of the background is represented by actual practical experience."
4. "Provided that the teacher doesn't try to impose his particular brand of knowledge on the pupils."

Response from NASSP

On this "science background" factor, 75 Ohio principals and 47 from the nation at large made a total of 122 who agreed while only one did not agree. None from Ohio disagreed, and there was only one qualification, from a non-Ohioan. It follows:

1. "Provided the teacher stays on a level which the children can understand."

Summary of Responses to Factor 1

Reference to Table II indicates very little disagreement on the part of respondents with the general sense of the factor. A total of 497 individuals agreed to the thesis set forth by factor 1, while only four disagree. Careful study of the qualifications offered indicates that in general, those who wished to qualify the statement were offering only minor extensions of it. For purposes of this study, factor 1 has been established as being of at least considerable force and worthy of a part in the remainder of the study.

Factor 2. Other factors being equal, effective learning is more likely to occur when the teacher has a functional knowledge of how children develop and how learning takes place.

TABLE III

RESPONSE TO FACTOR II

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	99	0	1
NSTA	158	1	3
AASA	128	2	3
NASSP	122	2	0
Total	507	5	7

NARST Responses to Factor 2

This second factor met almost universal acceptance from NARST respondents with 99 agreeing completely, one desiring to make qualifications, and with six making no answer. The qualifications listed by the one individual desiring to make changes were as follows:

1. "Wish also to add, 'And is willing to adapt his teaching procedures and standards of pupil achievement accordingly.'"
2. "Provided he parallels his method of approach with the way in which children learn and develop."

Responses from NSTA

As with the respondents from NARST there was little disagreement with factor 2 on the part of the respondents from NSTA. On this point, which dealt with child development and psychology of learning, 158 respondents agreed in total, one did not agree, and three wished to qualify their answers. These qualifications were as follows:

1. "If the knowledge really is used."
2. "Agree partially."
3. "For older teachers, yes, for beginning teachers, no."

Except for the first comment, these appear to be somewhat meaningless for purposes of this study, and seem not to be on a par in usefulness with most of the other comments received.

AASA Responses to Factor 2

Factor 2 was the recipient of 128 agreements also, while one Ohio administrator and one other disagreed. Three administrators, none of them from Ohio wished to amend the statement somewhat. These qualifications were:

1. "Plus the training in the field."
2. "If there is knowledge of growth at various levels."
3. "Actual experience in watching children grow and learn is beneficial."

NASSP Responses

The "child development and psychology of learning" factor rated approval by 122 individuals, 74 from Ohio, and disapproved by only two, one of whom was from Ohio. There were no qualified answers.

Summary of Factor 2 Responses

With less than one per cent of those who responded disagreeing with the factor, and with only a small number of rather minor extensions offered, factor 2 has been accepted as of worth for further use in the study.

Factor 3. Other factors being equal, effective learning is more likely to occur if the teacher knows about, understands, and uses a variety of methods of instruction as opposed to exclusive use of one or two methods.

TABLE IV

RESPONSE TO FACTOR III

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	87	2	11
NSTA	143	3	13
AASA	120	6	5
NASSP	111	5	8
Total	461	16	37

NARST Responses to Factor 3

Factor three was the first of the factors to evoke any disagreement from members of NARST who responded.

Two individuals disagreed rather thoroughly with the statement, holding that variety as such lent no degree of effectiveness. On the other hand, 87 agreed, and eleven agreed with certain qualifications as follows:

1. "Unless carried to a bewildering extreme." (Stated by two individuals).
2. "Statement not completely clear."
3. "Provided that the method selected is appropriate to the situation and that the teacher can use it effectively." (Stated in essence by six individuals).
4. "Providing that there is some consistency in the approach."
5. "Although some methods involve more interaction and are more effective than others."
6. "And also uses the right method at the right time."

NSTA Responses

Factor 3, which related to method, received much the same type of qualification which it had received from members of NARST who responded. The chief provision which most objectors wished to register was that too much variety might tend to confuse. This statement also is found in the qualifications listed by the NARST

members. Altogether 143 accepted the statement as it stood, three did not agree with it and 13 individuals wished to amend it somewhat. The qualifications follow:

1. "Too much variety may tend to confuse." (Eight respondents believed this statement to be true.)
2. "Not so much value to variety as to a selection of those methods which are most suitable."
3. "If within the level of understanding of the pupil."
4. "Agree in general, but statement may not be true with very slow learners."
5. "But not to the extent that none are mastered."
6. "But not to the extent of putting on a show."

The qualifications made by this group of respondents appear to be based upon a fear of setting up situations wherein the teacher tends to become merely a showman, and it is likely that this fear oftentimes is well founded. It is likely that this group of respondents, being for the most part practicing secondary science teachers see this problem more clearly than do certain other respondents.

AASA Responses to Factor 3

Factor three which was concerned with methods of teaching was approved by 120 of the administrators, 59 from Ohio and 61 from the nation at large. Five wished to qualify their approval in addition to these who approved outright (two of these being from Ohio), and six Ohioans did not agree. Qualifications were as follows:

1. "If used with pupils who need special help." (Ohio)
2. "Too great diversity can make teaching ineffective." (Ohio)
3. "Desirable, but if the 'one or two methods' used are effective, satisfactory learning will result."
4. "Too many methods may result in confusion, however, some variety is desirable."
5. "If methods are selected on the basis of effectiveness at respective age levels and for various developmental levels."

NASSP Replies

Factor three, that which related to methods, called forth opinions from several Ohio principals who wished to qualify their answers. While 65 in Ohio agreed, seven more wished to qualify. Nation-wide the score was 46 was agreed and one who wished to amend the statement. Five, two of whom were from Ohio, did not approve. The qualifications were:

1. "Providing the methods are educationally sound." (Ohio)
2. "Methods used must be within the comprehension of the student." (Ohio)
3. "Too many methods may cause confusion." (Three from Ohio)
4. "Methods used must be consistent with the long range plans of the class. (Ohio)
5. "Insofar as additional methods create and expand interests." (Ohio)
6. "When the teacher understands thoroughly the methods he is using."

Summary of Factor 3 Discussion

While less than four per cent of the respondees disagree with the statement, the tenor of qualifications indicated that there were several individuals who feared the use of so great a number of methods or techniques that the school might be turned into a three-ring circus. While the great majority of respondees were not alarmed by the possibility that such a situation was envisaged in the factor, it is suggested that the word functionally be inserted in factor be inserted in factor three to make the statement read: "Other factors being equal, effective learning is more likely to occur if the teacher knows about, understands, and uses functionally a variety of methods of instruction as opposed to the exclusive use of one or two methods."

Factor 4. Other factors being equal, effective learning is more likely to occur when the teacher is living the life of a normal citizen in the community, exerting community leadership appropriate to his educational position.

TABLE V
RESPONSE TO FACTOR IV

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	79	2	14
NSTA	119	25	12
AASA	114	8	7
NASSP	116	5	3
Total	428	40	36

NARST Responses to Factor 4

On this factor, again there was some disagreement, and many qualifications. While only two individuals disagreed, there were fourteen who desired to qualify their agreement, and several did not answer. Seventy-nine believed the statement to be valid.

Following are the qualifications listed:

1. "I believe it, but I believe there is no evidence to prove it."
2. "Believe this is true providing the time and energy taken is not too great." (Stated by five individuals)
3. "Providing we do not imply a doubt standard of morality."
4. "Believe the statement is not entirely clear."

5. "Providing the teacher knows how to relate learning to living and to the problems of the students in their community."
6. "The word 'normal' is confusing."
7. "Agree in theory. In practice it is hard to do since teaching itself takes so much time and energy."
8. "He should be outstanding in his community — not just 'normal.'"
9. "This is not always possible in large cities."
10. "But not always possible."
11. "Provided the teacher in so living is objective about the needs of youth as revealed by his participation in community activities and uses his knowledge of these needs in his teaching."
12. "True for those people whose mental health requires it."
13. "The teacher has no more responsibility than any other person."
14. "Tend to agree but see no positive evidence."

Certain qualifications may be of special importance, particularly that concerning the difficulty of carrying out the work implied by this factor in the very large community, since this point recurs many times in further portions of this study.

NSTA Responses to Factor 4

On factor 4, the practicing teachers of science seemed to be more likely to disagree than any other group. A very sizable group did not agree with the general thesis of this factor which concerned itself with the life of the teacher in the community.

Thus while 119 such respondents agreed, there were 25 who disagreed, and 12 who wished to qualify their agreement. Several did not answer this question or professed themselves unable to answer it. The qualifications follow:

1. "If the community activities do not encroach too much on the teacher's time and energy." (Stated in essence by six respondents.)
2. "However, the teacher must have tact."
3. "If it involves areas of science."
4. "But this may not hold true for large cities."
5. "With a time allotment for school preparation."
6. "However the teacher should not just do the jobs that no one else in the community will undertake."
7. "And his activities should make him appear as a desirable leader."

Apparently the teachers who gave comments number six and seven had much the same idea in mind--that the teacher should really engage in community leadership rather than just community drudgery. The investigator had hoped that this idea was implied in factor four, but it may not have been called out with sufficient clarity.

AASA Responses

The place of the teacher in the community called out more qualifications than most other factors insofar as the administrators were concerned. Seven of them, four from Ohio, accepted the state-

ment only with reservations, while four from Ohio and four from the rest of the nation did not agree to it at all. A few did not answer. In all, 114 agreed including 58 from Ohio and 56 from the other states. The qualifications were as follows:

1. "Highly desirable but perhaps not essential for a good learning situation." (Ohio)
2. "Should include the community in the teaching." (Ohio)
3. "Only as the teacher uses the community knowledge so gained to learn more about his students and their environment." (Ohio)
4. "Does not necessarily have to exert strong community leadership to be a good teacher." (Ohio)
5. "Certainly true in the small community."
6. "True in general but there are exceptions."
7. "Depends on the extent to which the community will accept the teacher as a citizen."

NASSP Responses to Factor 4

Five principals, two of them from Ohio, disagreed with the general thesis of factor four which concerns itself with the place of the science teacher in the community. On the other hand, 116 principals approved the statement. Of these, 73 were from Ohio. Three others approved with qualifications. None of these were Ohioans. The qualifications were:

1. "And is an inspiration to students."
2. "However, community leadership should not be over-emphasized."

3. "Depends on what the community considers normal."

Summary of Responses to Factor 4

In general, the statement was approved. Less than ten per cent of those responding disagreed with the statement, and of these few were found in the ranks of any group other than the National Science Teachers Association. Results indicated that if the sampling is representative, teachers of science felt less strongly the truth of the statement than did any other the other groups represented.

Comments concerning the factor were somewhat divided, some indicating desire for an extension of the factor, others indicating fear that the teachers will not, no matter what, be accepted as a normal citizen, exerting a degree of community leadership. Altogether, there was little in the collected responses to indicate drastic need for a change in the wording of the statement. It has been considered to have sufficient worth as it stands to be included in further portions of the study.

Factor 5. Other factors being equal, effective learning is more likely to occur in our society when the teacher has a well-thought-out and consistent philosophy of teaching and when the teaching practice is consistent with the stated philosophy.

TABLE VI

RESPONSE TO FACTOR V

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	90	3	7
NSTA	136	6	17
AASA	120	5	5
NASSP	102	9	13
Total	448	23	42

NARST Response to Factor 5

On this factor, 90 individuals were in agreement, but three disagreed and there were seven who wished to qualify their answers. The rest of the respondents did not answer this question. Qualifications ranged over the usual gamut, but most of them except for the last could be considered as rather an extension of the factor as given in the opinionnaire. These qualifications follow:

1. "The Teacher should constantly keep these in process of development."

2. "Desire to substitute, 'Purpose consistent with his own carefully considered theory.'"
3. "Do not believe that the philosophy needs to be 'Stated.'"
4. "Provided that the philosophy is a good one."
5. "Consistent (philosophy) within the profession of teaching and within the society."
6. "Also that he should know other philosophies and how he came by his own."
7. "Provided that such a philosophy is consistent with desirable educational practice."
8. "But the philosophy must be one that is conducive to learning."
9. "Know one's subject and then teach. The involvement of too much philosophy is dangerous."

NSTA Responses to Factor 5

Factor 5, which concerned itself with the philosophy of the teacher received what appeared to be rather careful consideration by the NSTA respondents. Of the number responding, six did not agree, but there were 136 who did, and there were 17 who wished to make some qualification. A few did not answer. The qualifications follow:

1. "But the philosophy shouldn't be too rigid." (Six individuals)
2. "Provided the philosophy and practice are consistent with the implications of modern educational research." (Two respondents)

3. "Moreover as his philosophy grows, his teaching practices should keep pace."
4. "Provided the pupil is conscious of the direction."
5. "Provided his philosophy is founded on true basic principles."
6. "Provided the philosophy is consistent with democratic living." (Three respondents believed this)
7. "Provided it includes the acceptance and practice of a sound code of professional ethics."
8. "If the philosophy is not in conflict with that of the school and community." (Three respondents indicated this)

Examination of the preceding comments indicates that most of these qualifications are, in reality, extensions of the statement of the factor rather than disagreements with portions of it.

AASA Responses

There was fairly universal agreement with factor 5 relating to the philosophy of the teacher, with the exception of qualifications reminiscent of those advanced by a number of representatives of the two preceding groups. Thus 120 agreed including 59 from Ohio, while five, four of whom were from Ohio, disagree. Three from Ohio desired to qualify their agreement, as did two others. These qualifications were:

1. "Would add, 'and that the philosophy be consistent with that of the school in which he teaches.'" (Ohio)
2. "Should be consistent but subject to revision." (Two Ohioans)

3. "If the philosophy is based on understanding of child growth and development."
4. "If it is held subject to revision."

NASSP Responses

Calling for more qualification on the part of members of the NASSP who responded than any other item was that referring to the philosophy of the teacher. Thirteen of these respondents, five of whom were Ohioans, qualified their approval, while nine (four from Ohio) did not agree. One hundred two, approved the statement (66 from Ohio). The qualifications were:

1. "Willing to change his philosophy as his outlook develops."
(Two from Ohio)
2. "Adjustments may be necessary." (Ohio)
3. "Should discuss and read, then temper the philosophy by application of new knowledge." (Ohio)
4. "Should practice the philosophy of the school." (One from Ohio and three from elsewhere.)
5. "If that philosophy is democratic and sound."
6. "Must recognize that the philosophy may have to be revised." (Two respondents)
7. "Should conform in general to community philosophy."
8. "Provided he has the 'right' philosophy."

Summary of Responses to Factor 5

Together with some valuable comments concerning this factor, there were a few which seemed to this investigator to be of very doubtful worth. In general, the statement was approved as it stood, and it has been considered that only one alteration need be made in the statement in the interest of a nearer approach to a valid statement. It has been suggested that the word "stated" be omitted from the sentence, in accordance with certain suggestions received from respondents.

Factor 6. Other factors being equal, learning will proceed more effectively when the teacher is skilled in the use of classroom aids and devices, when he is familiar with, has accumulated, and uses teaching materials of various kinds, and when he knows about and uses sources of information beyond the single textbook.

TABLE VII

RESPONSE TO FACTOR VI.

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	94	0	8
NSTA	162	0	1
AASA	131	0	2
NASSP	119	1	4
Total	506	1	15

NARST Responses to Factor 6

On factor 6, 94 of the respondents indicated agreement, none disagreed, and there were eight who wished to qualify their answers. The qualifications were as follows:

1. "That it not be overdone." (Four indicated this qualification)
2. "Desire that it read, 'And uses aids to accomplish his purposes.'"
3. "Provided that he can stimulate students to the use of these aids, etc."
4. "Provided he doesn't clutter up his teaching with gadgetry."
5. "However, this does not need courses in so-called education, just common sense."

NSTA Responses

There was more nearly universal agreement among the practicing teachers who make up the bulk of NSTA's respondents on factor six than on any other. A total of 162 individuals agreed with the statement concerning aids, devices, and use of information. None disagreed, and there was only one person who desired to insert a qualification. This was as follows:

1. "However, for the first period of his teaching, the teacher should use one text and practice developing and perfecting his techniques."

AASA Responses to Factor 6

Factor six, which related to classroom aids and devices was agreed to by 131 of the administrators, 66 of whom were from Ohio. One from Ohio and one other wished to qualify their acceptance, and there were no votes of disapproval. The two qualifications were:

1. "The teacher should use dramatic demonstrations to arouse interest and clinch teaching." (Ohio)
2. "Devices and aids should not be forced on the students."

NASSP Responses

Factor 6, which relates to the use of aids and devices met with at least partial favor with all but one of the NASSP respondents. There were 119 completely favorable answers, four (two from Ohio), who agreed partially, and one who did not agree at all. The four qualifications were as follows:

1. "If we do not over-mechanize with devices which turn the class into a show." (Ohio)
2. "To follow the text helps keep the student from becoming confused." (Ohio)
3. "The teacher must be familiar with the equipment."
4. "Must not substitute materials for ideas."

Summary of Responses to Item 6

The overwhelming approval given to item 6 by the individuals responding to it indicated that no change was needed in this statement. Only two individuals disagreed, and the suggestions given were chiefly in the direction of extension of the item.

Factor 7. Other factors being equal, learning will proceed more effectively when the teacher has established rapport with the learners and when the learners believe that the teacher is well informed and effective.

TABLE VIII

RESPONSE TO FACTOR VII

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	96	1	4
NSTA	151	0	8
AASA	131	0	2
NASSP	120	0	2
Total	498	1	16

NARST Responses to Factor 7

Factor 7 called forth almost universal agreement from NARST respondents and in this case all of the qualifications tended toward an amplification and accentuation of the statement. Only one person disagreed, while 96 agreed completely and four added qualifications. These were:

1. "Wish to add, 'And working for their success.'"
2. "More than rapport, he must be interested in them."
3. "Add, 'and human.'"
4. "Add, 'and is genuinely interested in helping them to learn.'"

NSTA Responses to Factor 7

Factor seven, which involved teacher-pupil rapport also seemed to be favored by these respondents, since none disagreed. There were eight, however, who wished to qualify the statement and 151 who approved it in the form given. A few did not answer. The qualifications were as follows:

1. "However, too great reverence for a teacher should be avoided since it leads to overdependence."
2. "But the teacher should not attempt to gain confidence by bluffing in order not to disclose ignorance."
(Three individuals believed this.)
3. "But the teacher should not be considered and used by the pupils as a handy encyclopedia."
4. "Provided friendliness does not degenerate into undue familiarity."

5. "Dependent upon mutual attempts at evaluation." (Stated in essence by two individuals)

AASA Responses to Factor 7

Perhaps the experience of administrators with teachers and pupils who are at odds with each other makes them especially ready to accept factor seven at face value. There were no disagreements with this factor concerning rapport between student and teacher, and only two, both from Ohio, wished to qualify their acceptance. Of the 131 voicing approval, 65 were from Ohio. The two qualifications were as follows:

1. "Provided we have desire for learning, not just 'getting by.'"
2. "Warmth and friendliness on the part of the teacher are essential."

NASSP Replies to Factor 7

As with the administrators, principals were very approachable on the subject of pupil-teacher rapport. There were 121 approvals, 73 of them being from Ohio; there were no disapproving votes, and two agreed with qualification. These qualifications were:

1. "So long as the teacher does not use his information to go too far beyond the pupils." (Ohio)
2. "Must guard against intimacy." (Ohio)

The first of these comments appears to be more applicable to factor 1, but it has been included in the place in which it was inserted by the principal replying.

Summary of Responses to Factor 7

As in the preceding item, factor seven received almost universal approbation, with most of the suggestions being in terms of minor extensions of the statement. No change in this factor was indicated.

Factor 8. Other factors being equal, learning will proceed more effectively when the major professional interest of the teacher and his major expenditures of time and energy are concerned with teaching and not with some other occupation.

TABLE IX

RESPONSE TO FACTOR VIII

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	91	3	8
NSTA	147	6	4
AASA	129	2	2
NASSP	118	4	0
Total	485	15	14

NARST Responses to Factor 8

Ninety-one individuals agreed with factor 8, but three disagreed and eight wished to qualify the statement. Certain of these qualifications apparently were not meant to question the statement as it stands, but merely to express economic facts. These qualifications follow:

1. "The teacher must, however, enter into the life and interests of the school community as well as the wider community--he must be a 'person.'"
2. "Would desire to qualify the term 'occupation.'"
3. "Provided opportunity is given the teacher to acquire the broad background required." (Two believed this)
4. "But not to the extent of outlawing avocations." (Two mentioned this)
5. "Unless the other concern is a related field."
6. "Plenty of women who are wives and mothers do excellent teaching and still maintain their homes."
7. "However teachers have to live."

NSTA Responses to Factor 8

Of the NSTA respondents there were six who disagreed with the thesis of factor 8 while 147 agreed and four wished to qualify their agreement. A few did not answer. The qualifications follow:

1. "However, teachers need the broadened outlook which comes from acquaintance with and experiences in other areas of endeavor." (Two indicated approval of this addition)

2. "Providing a reasonable amount of time spent in such things as scientific research is not excluded."
3. "In certain cases, work in the community can make a teacher more adequate in teaching because of increased community understandings."

AASA Responses

There was little disagreement with factor 8 which relates to the major professional interest and time of the teacher. One Ohioan and one other disagreed, while two Ohio administrators wished to qualify their answers. Of the 129 voicing approval, 64 were from Ohio. The qualifications offered were:

1. "There are exceptions."
2. "The outside work may give the teachers a needed interest."

NASSP Responses to Factor 8

All of the Ohio principals agreed with this factor, registering 75 approvals. Nation-wide, 43 approved, four did not agree, and the rest did not answer. This factor was concerned with the out-of-school interest and expenditure of time of the teacher.

Summary of Responses to Factor 8

Although there was some disagreement with this statement, the negative responses were rather few in number and somewhat scattered. Such qualifications as existed tended largely in the direction of interpretation. For example, several indicated that work which

was related to the work of the school, such as research, should not be excluded. These individuals, for the most part, seemed to be neglecting the fact that the factor had within it the term "major expenditure," which certainly did not bar a reasonable amount of related or unrelated outside work. The favorable response given this item is believed to be of sufficient scope that the item should not be altered and should be included for further study.

Factor 9. Other factors being equal, learning will proceed more effectively when there is rapport and mutual respect between the science teacher and his immediate supervisor.

TABLE X

RESPONSE TO FACTOR IX

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	88	4	7
NSTA	152	5	0
AASA	121	6	3
NASSP	116	3	0
Total	477	18	10

NARST Responses to Factor 9

On this factor, 88 of the respondents registered agreement, but four disagreed, finding no relationship between the classroom situation and the relationship between the teacher and his supervisor. Seven wished to qualify their answers, and several did not hazard an answer. The qualifications were given as follows:

1. "Provided they both recognize common purposes which are in agreement with acceptable theory and practice."
2. "Believe this is usually so, but not always."
3. "Infosfar as this reduces emotional strain on the teacher."
4. "Depends upon the type of person the supervisor is."
5. "True if this affects the mental health of the teacher."
6. "Providing this does not imply blind subservience to the supervisor."
7. "There are times, however, when the supervisor must register disapproval."

Factor nine gives opportunity for some interesting comparisons among the membership of NARST, among science teachers in the field as represented by the membership of NSTA and among supervisors and administrators.

NSTA Responses to Factor 9

This factor, which concerned itself with rapport and mutual respect between a teacher and his supervisor called forth either direct approval or disapproval from the respondents. There were no qualifying statements, although a few more than usual made no

answer or professed themselves unable to answer it definitely. Five did not agree, although 152 did agree with the statement as it stood.

AASA Response to Factor 9

Rapport between teacher and supervisor is viewed as being a valid factor affecting the learning situation by 121 administrators, 62 of them being from Ohio. Six, four of them Ohioans, do not believe so, and three, one from Ohio desire to qualify their answer. A few hazarded no answer to all. The qualifications are:

1. "Desirable, but not necessarily applicable to the learning situation." (Ohio)
2. "If the supervisor knows something about the field of work of the teacher."
3. "Does not include subservience of the teacher to the supervisor."

NASSP Responses

Factor 9 received favorable votes from all of the Ohio respondents who answered the question, receiving 72 affirmative responses. Nation-wide, 44 approved, while three did not agree, and the remaining few did not answer the question. There were no qualified answers.

Summary of Responses to Factor 9

While a scattered group of respondents disagreed with the thesis of factor 9, the number was relatively small. The comments made were, for the most part, not very pertinent when we take into consideration the statement, "Other factors being equal." No change was indicated in the statement of factor 9.

Factor 10. Other factors being equal, learning will be more effective if the teacher is not carrying an excessive load, either by reason of an excessive number of preparations, an excessive number of pupils per day, or an excessive extra-curricular or out-of-school series of responsibilities.

TABLE XI

RESPONSE TO FACTOR X

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	98	0	3
NSTA	159	0	1
AASA	131	1	0
NASSP	119	3	1
Total	507	4	5

NARST Response to Factor 10

No one wished to disagree with this factor although some felt that they would like to clarify it somewhat for their own use or to add to it somewhat. There were 98 in agreement, with three who wished to make some qualification; the remaining few did not answer it. The qualifications seemed to be somewhat less significant in this instance than for certain other factors and are given as follows:

1. "Would desire to limit it by further definition."
2. "The teacher needs some out of class contacts with students and with the program and the problems of the school."
3. "Desire to add, 'Or by reason of lack of adequate free time during the day for making preparations that cannot be made at home.'"
4. "However science teachers should engage in a fair share of extra-curricular activities."

NSTA Response to Factor 10

Factor 10 ranked very high in point of agreement, with only one person qualifying his answer. One hundred fifty-nine favored the statement, but there were several who did not answer it. The lone qualification offered by one respondent is as follows:

1. "Unless the teacher can understand and accept the need for the situation."

This qualification is really an extension of the factor beyond the point which this investigator believes is valid.

AASA Response to Factor 10

Concerning the matter of the effect of excessive load on the learning situation, the administrators were almost unanimous and none wished to qualify his position. A total of 131, of whom 65 were Ohioans believe the factor to be valid. One, an Ohioan, believed it to be not true. A few either gave no answer or gave an answer which could not be interpreted.

NASSP Responses

This factor, concerning teacher load, was approved by 119 respondents, 71 of whom were from Ohio. One Ohioan qualified his answer, while two Ohioans and one other did not agree with the factor as stated. The lone qualification was:

1. "Further definition desired."

Summary of Responses to Factor 10

This factor was another which met with almost universal agreement. Examination of the few qualifications which were made has indicated nothing in the way of an extension which has been felt to be necessary to the sense of the factor. This factor has been included as originally stated.

Factor 11. Other factors being equal, learning will be more effective in a school which has a wide variety of science offerings than in one which has a very limited number of such offerings.

TABLE XII

RESPONSE TO FACTOR XI

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	37	34	19
NSTA	108	27	10
AASA	83	33	11
NASSP	85	32	2
Total	313	126	42

NARST Responses to Factor 11

This factor caused wider disagreement than any other factor in the list. Apparently, a very large number of the respondents felt that number of courses offered by a school had little to do with effectiveness. Perhaps the factor should have been stated otherwise, perhaps there was some misunderstanding. As stated, the investigator meant over-all effectiveness of learning in the school, whereas comments indicated that at least some of the objectors were thinking of effectiveness of learning within a

particular class. Whatever the reason, 34 individuals expressed disagreement, while 37 believed that they approved the statement. Additionally, 19 approved the statement with one qualification or another (and these qualifications were quite varied.) Quite a large number made no attempt to answer this question. The qualifications follow:

1. "Agree in general, but am not quite sure."
2. "Agree within limits."
3. "Depends upon the individual student."
4. "True in general, but a wide-awake teacher may overcome the limitations by variations within the courses."
5. "Mere number is not so important as quality." (Four respondents gave this answer)
6. "Prefer a well planned, unified program." (This answer from one respondent who disagreed in general with the statement)
7. "Providing the school is well equipped to carry the broader list of offerings." (This answer from two respondents)
8. "If we mean general adjustment rather than learning in one area."
9. "Desire a better definition."
10. "Depends upon the future occupation of the students."
11. "Don't broaden the number too much--broaden the scope within the sciences."
12. "Offerings are not so important as the quality and continuity of the program."
13. "Provided an adequate corps of teachers is employed, and no teacher is required to spread himself too thin." (From two respondents)

14. "Only in that more varieties of students will be served."
15. "Depends upon the offerings."
16. "If it takes into account the needs of all kinds of youngsters."
17. "Type is as important as variety."

NSTA Response to Factor 11

Factor 11, which stirred up such great disapproval among the respondents from NARST likewise met many in the NSTA group who did not agree, although percentage wise this latter group offered less opposition. A much greater number, however, did not attempt to answer the question, or gave non-committal answers. Only 108 individuals professed to believe in the validity of this factor, while 27 disagreed and some ten had qualifications to their agreement. These qualifications were as follows:

1. "Provided that a wide variety in science is not offered at the expense of a balanced curriculum."
2. "If the offerings are not thereby spread too thin."
(Two believed this)
3. "If the students are permitted to take advantage of the wide offerings." (Three answered essentially in this manner)
4. "If the offerings are appropriate and not superficial."
(So said two commentators)
5. "Provided that we do not attempt to make specialists at high school level."
6. "Provided that the variety does not suppress a thorough knowledge of fundamental concepts."

AASA Responses

The problem of the breadth of offerings seemed to cause quite as much of a flurry in the ranks of administrators as with the other groups, a smaller number agreeing with this factor than with any other. A total of 83 administrators agreed, including 49 from Ohio. Disagreeing were 33, of whom one-third were Ohioans. Eleven, five from Ohio, wished to qualify their statements, and a few did not answer. The qualifications were:

1. "Depends upon the breadth of each offering." (Ohio)
2. "If they truly are science offerings and are taught well." (Ohio)
3. "Variety can be carried to the extreme." (Ohio)
4. "Providing the program has been soundly planned."
(Two from Ohio)
5. "Should not be spread too thin." (Two from outside Ohio)
6. "Depends upon how well instruction is suited to the individual members of the class."
7. "May be important to have a wide variety, but a lack of it is not necessarily fatal to good teaching."
8. "Depends upon the definition of learning."
9. "Limit agreement to general learning."

NASSP Responses to Factor 11

As with other groups, the respondents from NASSP were somewhat doubtful about factor 11. In Ohio, 57 approved, with fourteen registering disapproval. Nation-wide, the percentage was much less favorable to the proposed factor, 28 approving and 18

registering disapproval. One in each group wished to qualify his answer, while a few did not make clear their intentions.

The two qualified answers are given:

1. "But this does not affect learning within a given class."
(Ohio)
2. "Depends on the size of the school and of the class."

Summary of Responses to Factor 11

While almost two and one half times as many individuals agreed with item 11 as disagreed with it, there were indications that something was wrong, either with the concept or with the statement. The members of NARST, for example, who in general appeared to give more serious consideration to the items than did any other group, furnished a large number of the unfavorable votes. In fact, Table XII indicates that almost as many members of NARST disagreed with the statement as agreed with it wholeheartedly. Accordingly, taking into account the large number of qualifying statements, an attempt has been made to answer some of the more serious challenges to the statement as submitted. The final statement, taking into account as many of the valid suggestions as seemed to aid in clarifying the point at issue is:

Other factors being equal, the over-all pattern of school effectiveness will be greater (hence, learning will be more effective) in a school which has a wide, but not overbalanced, variety of science offerings than in one which has a very limited number of such offerings.

TABLE XIII
RESPONSE TO FACTOR XII

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	84	7	11
NSTA	141	8	5
AASA	124	6	0
NASSP	111	6	3
Total	460	27	19

NARST Response to Factor 12

Factors 12 and 13 were thought by certain individuals to be mutually exclusive. However, a great number of respondents were at pains to point out that these two factors were not exclusive, but that they should operate together to make for good teaching. There was some disagreement with factor 12, seven persons disagreeing, but 84 agreed that provision for special needs added to the effectiveness of learning. Eleven persons agreed with qualifications and the rest did not make any answer. The qualifications were as follows:

1. "Assuming that the questioner realizes that not all youth should attend college."
2. "Provided that we really know the needs."
3. "Provided that common needs are not neglected."
4. "The student should be taught definite subject matter regardless of the community, however, it helps somewhat to have a tie-up with the community."
5. "Provided that it is recognized that the special needs of one community will not differ radically from those of other communities."
6. "Providing that the students recognize these needs, accept meeting them as a definite purpose, and work with genuine interest toward meeting them."
7. "Desire to substitute 'taken into account' for 'directed toward.'"
8. "Desire further definition."
9. "If we are able to project these needs." (Two suggested this)
10. "Desire to extend the idea of the community beyond the strictly local sense."
11. "This is probable, but evidence is lacking."

NSTA Responses to Factor 12

Comments regarding factors 12 and 13 which dealt respectively with the "special needs" and the "general needs" indicated that there were quite a number of secondary teachers who thought of these two items as being mutually exclusive. However, 141 respondents agreed with factor 12, while eight did not agree and five agreed with qualification. These qualifications follow:

1. "Unless the community is over-specialized."
2. "If the special needs include moral and religious needs."
3. "Provided that the program doesn't become over-specialized."
4. "Provided that the attention given to these special needs leads into a program directed toward learning the fundamentals of science."
5. "Provided that we do not take too limited a view of the extent of the community."

AASA Response to Factor 12

This factor relating to caring for special needs evoked no comment. There was either agreement or disagreement, and the agreement was fairly general. Of the 124 agreeing, half were from Ohio, while two of the six who disagreed also were from this state. A few did not answer.

NASSP Responses

Factor 12, which referred to special learnings was approved by 111 of the NASSP respondents, while six, five of whom were from Ohio, did not agree. Three Ohioans agreed with qualification and a few did not answer. The qualifications were:

1. "True of rural or highly industrialized communities."
2. "Although this would still give a rather uniform program in city systems."
3. "Further definition desirable."

Summary of Responses to Factor 12

The chief difficulty in the minds of the respondents as they were reflected in the qualifying statements had to do with the feeling that the statement in some way negated the idea of the aims of general education. To avoid this misapprehension, the statement has been amended as follows:

Other factors being equal, more effective learning is likely to occur when the program of the school is directed toward providing for the special needs of the youth of the community (but not neglecting general needs) than when the program is not so directed.

Factor 13. Other factors being equal, more effective learning is likely to occur when the program of the school is directed toward providing for the general educational needs of youth than when the program is not so directed.

TABLE XIV

RESPONSE TO FACTOR XIII

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	84	6	8
NSTA	133	17	4
AASA	106	12	3
NASSP	103	9	5
Total	426	44	20

NARST Responses to Item 13

This factor called forth disagreement from six individuals, but 84 agreed with it in total and eight desired to qualify their answers. The same number made no response.

The qualifications were as follows:

1. "The Question is too indefinite."
2. "The statement is probably true for the majority, but not for the minority who may profit most from a speciality." (Stated by two respondents)
3. "That I be permitted to define 'general education.'"
4. "Desire to define these needs first."
5. "'General education' must not mean a sacrifice of fundamental learnings necessary for growth."
6. "Except in certain specialized schools."
7. "Depends upon the definition of 'general education.'"
8. "For most students but not for all."
9. "If general educational needs equal the actual needs."

NSTA Responses

As noted previously, factor 13 was opposed by several respondents, largely on the ground of a feeling of mutual exclusiveness between it and the preceding factor. Disagreeing were 17 respondents, while 133 agreed, and four wished to qualify their answer.

1. "Provided that the gifted children are not thereby neglected." (Two respondents held this to be a valid extension of the factor)
2. "Provided that the program is such that the youth see that their own problems are being treated."
3. "If the general and educational needs include moral and religious needs."

AASA Response to Factor 13

There was more disagreement among administrators with the factor concerning the general educational needs than with certain other factors. A total of twelve, one-third of them from Ohio, disagreed with the premise. Only 106 agreed completely, and three desired to qualify their approval.

These qualifications were as follows:

1. "If we can be sure of general needs." (Ohio)
2. "Provided that we can recognize them."
3. "Applies only when the program is practical and relevant."

NASSP Response to Factor 13

Reference to the generalized functions of the school as stated in factor 13 brought agreement from 103 respondents, including 62 from Ohio. Five Ohioans likewise wished to qualify their responses. Nine, four of whom were from Ohio, did not agree. The qualifications are as follows:

1. "But it must be constantly under observation."
2. "If general educational needs are chosen properly."
3. "True of small city and town schools."
4. "Depending on the make-up of the community."
5. "Further definition needed."

Summary of Responses to Factor 13

Because of similarity of responses and for the same reason as in the preceding factor interpretation, the statement of the item has been altered so that no one may interpret it as excluding education for special needs. The amended statement follows:

Other factors being equal, more effective learning is likely to occur when the program of the school is directed toward providing for the general educational needs of youth (but not neglecting the specialized needs) than when the program is not so directed.

Factor 14. Other factors being equal, learning will proceed more effectively when the learners and the teacher sense the direction of the teaching, when both participate in the planning, and when the learners see the fulfillment of their own aims implicit in the objectives of the course.

TABLE XV
RESPONSE TO FACTOR XIV

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	82	7	11
NSTA	137	4	13
AASA	113	5	12
NASSP	116	3	6
Total	448	19	42

NARST Response to Factor 14

Of the 106 respondents, 82 agree with this factor as stated, and seven disagree. Of those eleven who wish to qualify the statement before accepting it, most appear to question some phase of the inclusion of pupils in the planning. Some see difficulty in this area while recognizing that it is defensible as a goal.

The comments follow:

1. "Depends on whether the teacher is skilled in this type of thing."
2. "A feeling that 'their own aims' has been interpreted too narrowly by modern pragmatists."
3. "Desire to insert the idea that the aims should be worthwhile."

4. "If the student has the ability to plan."
5. "The idea is good, but it is difficult to apply in large classes."
6. "This is hard to do, but we try."
7. "Student participation must be commensurate with the abilities of the several students to participate--the teacher must lead." (This comment was voiced by four individuals)
8. "Students should participate in some of the planning."
9. "Pupil planning is not necessary in the initial stages."
10. "Agree with the statement except for pupil participation in the planning."

NSTA Response to Factor 14

The chief qualifications listed for factor 14 seemed to stem from the fact that many teachers feared somewhat the results of too much pupil planning in a situation. They seemed to fear that the inadequate teacher would permit pupils simply to "take over" the conduct of the class and permit the class to degenerate into chaos. Even with many who agreed with factor 14 in principle there seemed to be some hesitancy regarding the desire to get the pupils into the planning in all situations.

While only four disagreed, there were 13 who agreed with qualification, and 137 who agreed either outright or with little significant comment. The qualifications include the following:

1. "If the planning stops at planning general aims--not the day-by-day lessons."
2. "If planning is held within the maturity level and ability of the class."
3. "Provided that the teacher remains in general control and that the students do not 'take over.'" (Two respondents)
4. "Providing the degree of participation is limited."
5. "If the aims of neither pupil nor teacher are selfish in nature."
6. "If time is adequate for this type of organization."
7. "If the teacher has the requisite skill." (Two respondents)
8. "If the pupils participate through the teacher, and if final direction remains in his hands."
9. "If classes are small enough to permit individual guidance."
10. "If the students' educational and cultural background is adequate for this responsibility." (Two respondents)

The investigator cannot help but feel that the preceding remarks are colored in part by individual experiences in attempts at teacher-pupil planning, or by rather direct observations of work involving teacher-pupil planning, some of which may have been inept.

AASA Responses to Factor 14

As with the teachers themselves and with the trainers of teachers, the administrators were inclined to hedge a little on their agreement with pupil planning. While 113 agreed (55 from Ohio), twelve other administrators desired to qualify agreement, and five, two of whom were from Ohio, did not agree. The qualifications follow:

1. "Not necessarily including the pupils." (Ohio)
2. "May be handled by the superior teacher--otherwise look out!" (Ohio)
3. "Providing the learner's participation is limited." (Ohio)
4. "Agree with the theory, but have seen very little of it actually practiced." (Ohio)
5. "Very difficult for many high school youth to do." (Ohio)
6. "Guidance certainly is essential to visualize the proper end." (Ohio)
7. "Don't over-emphasize pupil participation in planning." (Ohio)
8. "But not 'What shall we do today, pupils?' The Teacher's wealth of knowledge is the classes' greatest resource." (Ohio)
9. "Assuming proper student maturity."
10. "But teacher guidance is essential."
11. "If the teacher is the leader."
12. "For the really good teacher."

NASSP Responses

Only three individuals, two of whom were from Ohio, objected to this factor, which involves the planning situation. A total of 116 agreed with the statement, while six, all from Ohio, wished to qualify it. Of those agreeing without qualification, 67 were from Ohio. The qualifications follow:

1. "Add 'parent' into the planning situation."
2. "Providing the teacher remains the leader."
3. "This procedure needs very careful direction."
4. "If the aims are practical and worthwhile."
5. "If the class and community thoroughly understand the planning."
6. "This procedure requires real skill on the part of the teacher."

Summary of Comments Concerning Item 14

There seemed to be no confusion concerning the intent of factor 14. While some individuals disagreed, and others desired to qualify their agreement, the disagreement was not pronounced. Neither was there any general trend in the qualifying statements which might indicate a desired change in the item. This statement has been included as it was originally propounded.

Factor 15. Other factors being equal, learning will proceed more effectively if the amount and type of laboratory equipment needed to fulfill the aims of the work is present and in operating conditions, and if the number and type of aids, devices, supplies, and materials are at hand and in condition to be used.

TABLE XVI
RESPONSE TO FACTOR XV

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	92	2	7
NSTA	152	1	6
AASA	122	0	11
NASSP	110	7	7
Total	476	10	31

NARST Responses

There was little general disagreement among NARST respondents with this factor, only two of the total number who answered disagreeing with the statement. Seven desired to qualify their answers, while 92 agreed. The remaining few did not answer.

The qualifications are as follows:

1. "Although there is some conflicting evidence. In some cases at least, the students benefit from having to make their own apparatus."
2. "Provided the laboratory experience is not of the 'cook-book' variety."
3. "Provided the teacher knows how to use it wisely."
4. "Provided we make sure that these items actually contribute to the learning."
5. "Add, 'and used'." (This item was suggested by three respondents)
6. "Building one's own equipment is probably superior in some cases to use of commercial equipment."
7. "Unless the use of conventional equipment robs the teacher and the pupil of a chance to improvise and construct their own."

NSTA Response to Factor 15

Factor 15 was approved by almost all of the NSTA respondents. There were 152 who agreed in substance; six, who desired to qualify their agreement; and only one who disagreed. The qualifications resembled those offered by the somewhat larger number of NARST respondents who wished to qualify their answers. The qualifications follow:

1. "If the equipment is properly used." (Two respondents)
2. "If the value of homemade and improvised equipment is not lost sight of." (Four respondents)
3. "If sufficient time is provided for the use of the equipment."

AASA Response

Factor 15, which treats of the adequacy of laboratory equipment and materials was acceptable to all of those replying, however, 11 individuals, five of these being from Ohio, wished to qualify it. Acceptance without qualification was indicated by 122, 62 of whom were Ohioans. All five of those from Ohio indicated the same qualification.

The qualifications were:

1. "There is much value in using improvised and homemade equipment." (Five Ohioans and three others)
2. "If the equipment is used well." (Two respondents)
3. "However simple devices are most effective when it is possible to use them."

NASSP Responses

Much the same type of qualifications were made by NASSP members concerning this item, as were made by other groups. In Ohio, 68 approved the statement, with 42 in the remaining states doing likewise. Seven individuals, four of them from Ohio, wished to qualify their approval, while the same number exactly, registered disapproval. The qualifications follow:

1. "If the values incident to improvising, constructing, and repairing equipment are not thereby lost." (Three from Ohio, one from elsewhere)

2. "Provided the equipment is properly used." (Ohio)
3. "The student may lose the principle in the technique."

Summary of Responses to Item 15

With only a sprinkling of individuals in the various groups in opposition to the idea expressed in factor 15, and with little question concerning the interpretation of the factor, it has been adopted as stated. While some individuals expressed the feeling that students often need to make their own apparatus and equipment, it was felt that this statement of itself detracted nothing from the general validity of the factor.

Factor 16. Other factors being equal, learning will proceed more effectively in a good physical environment than in a poor one.

TABLE XVII

RESPONSE TO FACTOR XVI

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	89	1	7
NSTA	155	4	1
AASA	126	3	3
NASSP	121	2	0
Total	491	10	11

Response from NARST Membership

This factor seemed to cause more difficulty with regard to definition than any of the other sixteen factors. Several of the respondents objected to the terms as given, claiming that they were not clear. Although only one person disagreed with the statement, and 89 approved, there were seven who wanted to qualify it, and quite a number who did not hazard an answer. Following are the comments:

1. "Object to 'good environment' as being a meaningless term." (Two respondents gave this comment.)
2. "Environment must be thought of as extending beyond the walls of the schoolroom."
3. "Except that poverty of environment may become a center for worthwhile study and action by a group--as action coming from a study of classroom illumination."
4. "Needs further definition." (Six of those who qualified their answers believed this.)
5. "Usually, but not always true."

NSTA Response to Factor 16

Less objection was made to the term "good physical environment" by the practicing teachers of secondary science represented in the NSTA respondents than by the NARST group. Only four did not agree with the statement and 155 agreed. There was only one qualification, and it seemed to be entirely sensible and to the point. It was:

It was:

1. "But fine teaching can largely overcome environmental handicaps."

AASA Responses

There seemed to be little argument from the membership of AASA over terms used in factor 16. Whereas, respondents on the NARST list had tended to request better definition of terms, this item was not prominent among the administrative answers received. Of the 126 who agreed, half were from Ohio. Three Ohioans desired to qualify their answers, and three, one of whom was from Ohio, did not agree. A few did not answer or made indefinite answers. The qualifications given were as follows:

1. "Although an otherwise good learning situation will overcome many poor physical factors."
2. "The laboratory should have atmosphere to impress the senses."
3. "However, the teacher is still the biggest factor."

NASSP Responses

Principals seemed almost universally to believe in the efficacy of a good environment. All of the Ohioans reporting, 75 in number, approved this point. Of those in the remaining states, 46 approved, two did not agree, and the remaining few did not

answer. There were no qualified approvals.

Summary of Responses to Factor 16

Despite the tendency on the part of a few members of NARST particularly, to quibble about the definition of the terms, the item seemed to be generally understood and approved. Hence, it has been included verbatim as it appeared in the mimeographed form.

Factor 17. Other factors being equal, learning will be likely to be more effective when considerable attention is given to problem solving, development of critical thinking and scientific attitudes.

TABIE XVIII

RESPONSE TO FACTOR XVII

Organization	Response		
	Agree	Disagree	Qualified Agreement
NARST	96	1	3
NSTA	150	4	1
AASA	127	2	1
NASSP	105	9	6
Total	478	16	11

NARST Response to Factor 17

Only one respondent of the 106 disagreed with this statement, and three wished to qualify it. Of the remainder, 96 agreed with it, six did not answer. The qualifications may be said to be mostly additive in nature and are given as follows:

1. "Can there be learning without problem solving?"
2. "Desire that attention be devoted to these factors consistently through the course."
3. "If the problems solved are real problems."
4. "Depends on the kind of learning sought."

NSTA Response to Factor 17

The "problem solving" factor was well taken by the great majority of NSTA respondents, only four disagreeing with it. There were 150 agreements, and one qualification. Several did not answer, however. The lone qualification was as follows:

1. "Except in the case of relatively poor groups."

AASA Responses to Factor 17

The investigator was somewhat surprised to find the rather complete agreement of administrators with factor 17 which relates to problem solving. There was only one who qualified his answer, whereas 127, 64 of whom were from Ohio, agreed to it. There were

only two who did not agree, and a few did not answer. One of the two who did not agree was from Ohio. The lone qualification was:

1. "On the thinking level of the pupils." (Ohio)

This qualification appears to be merely a slight extension of the general thesis.

NASSP Responses

Problem solving as an efficacious procedure in teaching was approved in the form listed in factor 17 by 105 respondents, 64 of whom were from Ohio. Six, half of them from Ohio, agreed with qualification, while nine individuals, five from Ohio, did not agree. The remaining few did not answer. The qualifications listed were as follows:

1. "Providing we remember that a background of knowledge must come first." (Ohio)
2. "True if the problems are kept within the ability of the student." (Ohio)
3. "Providing that problem-solving is developed in an intelligent manner." (Ohio)
4. "Providing that the material is not too complicated."
(Two from outside Ohio)
5. "True only of upper-bracket students."

Summary of Responses to Factor 17

A study of the qualifications listed for this item indicates that most were in the nature of slight extensions of the factor

as stated. This fact, together with the fact that there was a very limited number of negative votes has caused the investigator to include the item as it originally appeared.

Additional Factors Suggested

In the mimeographed form submitted to the membership of the four organizations, space was left so that respondents might add factors which they felt to be important in effective science teaching. Many of those who answered took advantage of the invitation, and a rather large number of additional factors was suggested. Although these factors have not been used in this study, since in no case was a factor suggested by more than a few individuals, they have been included so that other students who wish to proceed further may conceivably make use of them. They have been included in four separate lists, depending on the affiliation of the individual making the suggestion.

Additional Factors Suggested by One or More Members of NARST

Other factors being equal, learning will proceed more effectively:

1. If opportunity is given for practice in life outside the school.
2. When learning proceeds in such fashion that it gives satisfaction.

3. When secondary teachers are agreed upon common objectives.
4. When learning is directed toward action rather than merely when learning about something.
5. When teacher and student are in good health, with time to relax and rest.
6. When the teacher is relatively free from family troubles.
7. When the teacher is teaching children and not subjects.
8. When students enter actively into the activities rather than passively watching and listening to the teacher.
9. When the teacher has a good teaching personality.
10. When there is a reasonable amount of content per unit of time.
11. When there is a reasonable background of experience on the part of the learner.
12. When there is adequate exposure to direct, firsthand experience during the learning process.
13. When the teacher approaches the task with an attitude of personal interest and challenge and makes it clear that he too is willing, able, and likely to learn something.
14. When every classroom is made a laboratory for learning.
15. When there is parental co-operation and encouragement.
16. When the learner has proper food and care.
17. When social opportunities and adjustments are satisfactory.
18. When the learner has opportunities to have concrete experiences.
19. If the teacher is healthy, reasonably happy, and reasonably mature (for his age).
20. When the matter under consideration is kept in its simplest form and the minimum number of points of interest presented at any one time.

21. If the personality and the voice of the teacher are such as to make a good impression.
22. If the learner is helped periodically to measure his own growth.
23. If the content has clear significance for currently accepted important goals, usually practical in nature.
24. If adequate criteria of learning are applied to all of the objectives of the course (and possibly of the school).
25. If a good system of tenure is in effect, if there is good in-service training, and if interest is high in professional associations, professional reading, etc.
26. If there is rapport and co-operation among the various teachers within the system.
27. When the teacher has available and uses an instructional guide with an abundance of varied suggestions for teacher and pupil activities.
28. If the teacher has an understanding of the language used, and imparts this to the pupils.
29. If the research attitude is present.
30. If the teacher is physically and mentally in a state of well-being.
31. When the teacher is able to break down the general learning situation into all of the specifics needed for learning.
32. When an air of discipline and respect for the teacher are present.
33. When real objects and realistic problems are used in instruction rather than substitutes for real objects and teacher-posed problems.

34. When the teacher is well grounded in his subject and enthusiastic about it. -- He must have some real psychology--not educational psychology. He must work at his job--teaching is no place for a lazy man--The student must work--they do very little of it now--Education as such has brought our science program to such a low level it will take two generations to get back to mastery should we start now.
35. When there is a variety of activities to enable the student to gain an understanding of the variety of action in making wise choices.
36. If learning proceeds from problems significant to the student.
37. If instruction allows for firsthand experience with objects and processes in the natural and technological environment.
38. If the learning process involves frequent evaluation.
39. If a substantial majority of the students are from "good" homes with intelligent parents who encourage study and appreciate a teacher's efforts.
40. If the substantial majority of the students are of high intelligence.

Additional Factors Suggested by NSTA Respondents

Percentage-wise and numerically the NSTA respondents did not furnish quite as many additional factors as did the respondents from NARST. There were 34 suggestions, however, and these are listed herewith:

Other factors being equal, learning will proceed more effectively:

1. If the size of the class is not too great.
2. If the teacher has time to care for apparatus, etc.

3. If the teacher has a good conception of the background of each pupil prior to having the pupil in class.
4. If the science teacher assumes the role of a human being, not that of a "Supreme Being."
5. If the students acquire a facility in the use of the scientific method in solution of all kinds of problems.
6. If learning is made general.
7. If the teacher is a "helper," not a "leader," or, least of all, a "driver."
8. If the situation challenges the student to his capacity.
9. If numerous opportunities are given for the student to return to the sources of information.
10. If the pupil is brought directly into contact with science in his life.
11. If the science relates directly to true problems of living.
12. If the student is stimulated to use his intellect, talent, and abilities to the maximum.
13. If the teacher is high-minded, zealous, well-trained, and broadly educated.
14. If the teacher is reasonably facile in the use of precise English.
15. If the teacher has a pleasing personality.
16. If the teacher is properly compensated financially.
17. If the attitude of the public toward the school program is favorable toward a good educational program and to the responsibilities and duties entailed thereby.
18. If the teacher is spared frequent administrative interruptions.
19. If ability grouping is followed, and the work of the course is in accordance with the abilities of the groups.

20. If there is rapport and co-operation in evidence between the teacher and his colleagues.
21. If proper discipline is in effect.
22. If the teacher has some real experience in industry or work in fields other than teaching.
23. If the parents of learners are interested in the school and in other local institutions.
24. When amicable parent-teacher relations exist.
25. Provided that learners are treated as individuals with individual needs.
26. If co-operative planning is in effect between the elementary and secondary schools.
27. If the pupils and the teacher are in good physical and mental health.
28. If the teacher understands motivation and can motivate pupils.
29. If the teacher has the opportunity for professional growth.
30. If the teacher has energy, enthusiasm, good health, a genuine liking for his work, a fondness and liking for youngsters and has his own self-respect.
31. If current science materials are given importance in the work.
32. If there is a wholesome attitude toward learning in the home.
33. If the school is administered by good and efficient administrators.
34. If the learning situation is so managed that problems develop for the learner, and if at least a part of these problems relate to the community.

Further Factors Suggested by Administrators

The administrators responding to the opinionnaire suggested fewer additional factors than did either of the groups of science men. However, fifteen such factors were suggested, the first eight of which came from Ohio administrators. These fifteen factors are as follows:

Other factors being equal, learning will proceed more effectively:

1. If students have superior guidance.
2. If there is a considerable emphasis on current science, the function of science in a modern society, and the best vocations for those interested in science.
3. If the personality of the teacher is favorable to development of the student.
4. When the learner senses clearly the meaning of the learning in terms of its immediate or future value to him.
5. If immediate application can be made or seen.
6. If teachers have developed techniques of questioning which induce critical thinking.
7. If the teacher has and uses knowledge about the backgrounds of the pupils.
8. If there is proper feeling between the teacher and the student.
9. When the pupils in advanced sciences are selected carefully on a basis of proved interests and abilities.
10. If the teacher is in control of the classroom situation at all times.
11. If the social implications of science are emphasized.

12. If the pupils have a reasonably uniform ability and background of experience and preparation.
13. If the teacher personally likes children and is interested in them as individuals.
14. When the teacher's time and energy are not dissipated by meaningless bookkeeping.
15. When the teacher's personality and attitude are favorable for the development of learning.

Additional Factors Suggested by NASSP Respondents

This group of respondents suggested a smaller number of additional factors than did any other group. The Ohio principals responding suggested three, while the other individuals suggested an additional five, some of which were suggested by other groups. They follow:

Other factors being equal, learning will proceed more effectively:

1. If the teacher invites the co-operation of the child and is sympathetic to the child's viewpoint.
2. If the teacher is of good character.
3. When students help each other.
4. If the teacher is in command of the situation.
5. If more pupil participation is obtained.
6. If the personal appearance and personality of the teacher are favorable.
7. If the teacher lives by a code of ethics.
8. If a good and consistent program of school-community understanding is in progress.

Of these, Ohio principals suggested the first three.

Re-Statement of Factors of Effectiveness

For purposes of further investigation, the seventeen factors proposed have been revised somewhat in the light of the reports from the several hundred individuals representing four organizations who responded to the opinionnaire. A re-statement of the seventeen factors has been included as follows:

Other factors being equal:

1. Effective learning is more likely to occur when the teacher has a broad background of knowledge in the particular science he is teaching as well as in the related scientific areas.
2. Effective learning is more likely to occur when the teacher has a functional knowledge of how children develop and how learning takes place.
3. Effective learning is more likely to occur if the teacher knows about, understands, and uses functionally, a variety of methods of instruction as opposed to the exclusive use of one or two methods.
4. Effective learning is more likely to occur when the teacher is living the life of a normal citizen in the community, exerting community leadership appropriate to his educational position.
5. Effective learning is more likely to occur in our society when the teacher has a well-thought-out and consistent philosophy of teaching and when the teaching practice is consistent with the philosophy.
6. Learning will proceed more effectively when the teacher is skilled in the use of classroom aids and devices, when he is familiar with, has accumulated, and uses teaching materials of various kinds, and when he knows about and uses sources of information beyond the single textbook.

7. Learning will proceed more effectively when the teacher has established rapport with the learners and when the learners believe that the teacher is well informed and effective.
8. Learning will proceed more effectively when the major professional interest of the teacher and his major expenditures of time and energy are concerned with teaching and not with some other occupation.
9. Learning will proceed more effectively when there is rapport and mutual respect between the science teacher and his immediate supervisor.
10. Learning will be more effective if the teacher is not carrying an excessive load, either by reason of an excessive number of preparations, an excessive number of pupils per day, or an excessive extra-curricular or out-of-school series of responsibilities.
11. The over-all pattern of school effectiveness will be greater (hence, learning will be more effective) in a school which has a wide, but not over-balanced, variety of science offerings than in one which has a very limited number of such offerings.
12. More effective learning is likely to occur when the program of the school is directed toward providing for the special needs of the youth of the community (but not neglecting general needs) than when the program is not so directed.
13. More effective learning is likely to occur when the program of the school is directed toward providing for the general educational needs of youth (but not neglecting the specialized needs) than when the program is not so directed.
14. Learning will proceed more effectively when the learners and the teacher sense the direction of the teaching, when both participate in the planning, and when the learners see the fulfillment of their own aims implicit in the objectives of the course.
15. Learning will proceed more effectively if the amount and type of laboratory equipment needed to fulfill the aims of the work is present and in operating condition, and if the number and type of aids, devices, supplies, and materials are at hand and in condition to be used.

16. Learning will proceed more effectively in a good physical environment than in a poor one.
17. Learning will be likely to be more effective when considerable attention is given to problem solving, development of critical thinking and scientific attitudes.

Application of the Factors

As has been indicated in Chapters I and II, three chief sources of data were used in making application of the factors of effectiveness to secondary school science teaching in Ohio. These sources were:

- (1) Primary sources of information such as principal's reports, and reports of the state school examiners.
- (2) Questionnaires submitted to every teacher or science subjects in every public secondary school of general nature in the State of Ohio as of the school year 1950-51.
- (3) Personal investigation (the forty-teacher study).

Further portions of this thesis have been concerned chiefly with the presentation, analysis and discussion of the data gathered from these sources which bear on the application of factors of effectiveness to science teaching in Ohio.

Particularly in the forty-teacher survey, cognizance has been taken of the idea that factor effectiveness must not be confused with total effectiveness in a teaching and learning situation.

CHAPTER V

THE TRAINING AND EXPERIENCE OF SCIENCE TEACHERS IN OHIO'S PUBLIC SECONDARY SCHOOLS*

Science, in the public secondary schools of Ohio, was taught during the school year 1950-51 by 2544 individuals, of whom 2162 or almost 85 per cent were men. Of the 2544, just a few less than half, or 1270 were teaching in the county schools, 183 were in the exempted village schools, and 855 were teaching in the cities. The reason for the greater number of science teachers in the rural schools as compared with the cities is not difficult to establish. Whereas more of the teachers in the cities were in the one area of science for all or a major part of their teaching, many rural teachers were teachers of science for only a period or two a day, having responsibilities in other fields during the rest of their teaching time. The figures given include not only all who are full-time, or major-time science teachers, but also all who taught even one class of science per day, and included a few who were only part-time (as opposed to full-time) teachers. They included supervisory and administrative personnel who had science teaching responsibilities, even though these responsibilities included only one science class. In short, since this study was

*

Data extracted from reports of Ohio's secondary school principals for the school year 1950-51. Data from Covington, and from Felicity-Franklin school in Clermont County were not included since their reports were not on file at the time the data were taken.

aimed more directly at science teaching than at science teachers, every person in the state of Ohio was taught one or more classes of any kind of secondary-school science in the public secondary schools (aside from pure vocational schools) was included (except for the two schools previously mentioned).

Further data concerning numbers and percents of teachers of public school secondary science are shown in Table XIX.

Types of Degree Held by Science Teachers

Training of Ohio's secondary-school teachers in terms of degrees held has been calculated. This calculation showed that insofar as comparison might be made between teachers with Master's degrees and those having the baccalaureate degree, only the city schools were far in front of schools in the other two classifications. In the cities, there were as many teachers with Master's degrees as with bachelor's, while in neither of the other classifications were the percentages nearly so high. Exempted villages, for example, had a little less than 31 per cent of their science teachers presenting a Master's degree as compared with a little over 69 per cent of their teachers having only the bachelor's. The rural schools showed only a little over 22 per cent of their teachers having advanced as far as the Master's degree. Stated in still another way, the modal degree among teachers in county schools was the Bachelor of Science degree, as it was with the teachers in the exempted village schools. For teachers in the

TABLE XIX

NUMBER, SEX, AND DISTRIBUTION OF OHIO'S SECONDARY SCIENCE TEACHERS

Type of School	Total Number of Teachers	Number of Men	Number of Women	Per cent of men	Per cent of women	Per cent of total number of Teachers in Ohio
County	1476	1270	206	86.05	13.95	58.02
Exempted Village	208	183	25	87.98	12.02	8.17
City	860	709	151	82.44	17.56	33.81
Total	2544	2162	382	84.98	15.02	100

city schools, on the other hand, modal degree was the master's.

Six teachers of science in the State of Ohio had progressed to their doctorates. Of these, four were in the city school systems, while two were in the county schools. The four in the cities were men, the two in the county schools were women.

All of the preceding figures, as well as those in the tables which follow, are subject to minor correction due to the fact that there were five men teachers in the cities, four men and one woman in the county schools, and one man in the exempted village schools for whom returns were so meager as to lack meaning.

Recency of Training

While data relating to recency of training were somewhat indirect, some conclusions may be reached concerning recency of training.

As may be expected, an analysis of information concerned with recency of highest degree shows the greatest proportion of recently trained teachers to be in the county schools. For example, science teachers in the county schools receiving their degrees in 1949 and 1950 (the two years prior to the study) comprised a total of over 32 per cent of all of the teachers in the county schools for whom data were sufficiently complete to determine answers. Thus, while practically one-third of the county teachers had received their most recent degree within the two years prior to

TABLE XX

DEGREES OFFERED BY TEACHERS IN OHIO'S COUNTY SCHOOLS WHO WERE TEACHING ONE OR MORE
CLASSES OF SCIENCE*

Type of Degree	Number of Men	Number of Women	Total Number	Per cent of men	Percent of women	Total per cent
None	12	5	17	0.95	2.14	1.15
Bachelor of Science	490	88	578	38.7	42.8	39.3
Bachelor of Science in Education	209	31	240	16.5	15.1	16.3
Bachelor of Arts	254	58	312	20.0	28.3	21.2
Total Bachelors	953	177	1130	75.2	86.2	76.8
Master's Degree	301	21	322	23.8	10.4	21.83
Doctoral Degree	0	2	2	0	0.97	.13
Totals	1266	205	1471	100	100	100

* To these totals add four men and one woman for whom data were incomplete.

TABLE XXI

DEGREES OFFER BY TEACHERS IN OHIO'S EXEMPTED VILLAGE SCHOOLS WHO WERE TEACHING ONE OR MORE
CLASSES AT SCIENCE*

Type of Degree	Number of men	Number of women	Total number	Per cent of men	Per cent of women	Total Per cent
None	0	0	0	0	0	0
Bachelor of Science	76	6	82	40.9	24.0	39.6
Bachelor of Sc. in Education	19	6	25	10.43	24.0	12.06
Bachelor of Arts	27	9	36	14.82	36.0	17.4
Total Bachelor's	122	21	143	66.15	84.0	69.06
Master's Degree	60	4	64	32.9	16.0	30.9
Doctoral Degree	0	0	0	0	0	0
Totals	182	25	207	88.0	12.0	100

*

To these totals add one man for whom incomplete information was given.

TABLE XXII

DEGREES OFFERED BY TEACHERS IN OHIO'S CITY SCHOOLS WHO WERE TEACHING ONE OR MORE CLASSES
OF SCIENCE*

Type of Degree	Number of men	Number of women	Total number	Per cent of men	Per cent of women	Total Per cent
None	7	0	7	1.0	0	0.82
Bachelor of Science	195	35	230	27.7	23.7	26.9
Bachelor of Sc. in Education	35	11	46	4.97	7.3	5.4
Bachelor of Arts	110	36	146	15.6	23.8	17.1
Total Bachelor's	340	82	422	48.27	54.3	49.4
Master's Degree	353	69	422	50.02	45.7	49.4
Doctoral Degree	4	0	4	.57	0	0.47
Totals	704	151	855	100	100	100

*

To these totals add five men for whom data were incomplete.

the study, only a little over one-tenth of the city teachers had received their most recent degree during the same period of time. The exempted village teachers approached the county teachers in this respect more nearly than they did the city teachers, since well over one-fourth or approximately 28 per cent of the exempted village science teachers were found in this category.

Similarly, the highest percentage of teachers who had received their latest degree many years ago was to be found in the city schools. Over one-tenth of the city teachers for whom records were reasonably complete had received their most recent degree at least 30 years ago, while in the county schools the percentage on this item was less than one and a half per cent (approximately 1.1 per cent) and in the exempted villages the percentage was even less.

Further analysis shows that over half of the city science teachers received their most recent degree prior to 1940, whereas in the county schools, half or more of the teachers had received their degrees since 1945, or roughly since the end of World War II. For exempted villages, the mid-point in time for the most recent degree was during the war period, 1940-44.

Only two exempted village teachers, and only 17 county teachers had not received a degree since 1920, as compared with 88 city teachers who, as has been noted, comprised over ten per cent of the total number teaching science in the city schools.

Further data concerning recency of training are found in the following tables:

TABLE XXIII

DATE OF MOST RECENT DEGREE OFFERED BY TEACHERS OF OHIO'S
COUNTY SCHOOLS WHO TAUGHT ONE OR MORE CLASSES OF SCIENCE

Date of Degree	Men	Women	Total
1950	226	21	247
1949	208	19	227
1948	114	18	132
1947	53	7	60
1946	32	6	38
1945	11	7	18
1940-44	166	31	197
1935-39	182	25	207
1930-34	145	31	176
1925-29	70	25	95
1920-24	31	9	40
Prior to 1920	16	1	17
Totals	1254	200	1454

TABLE XXIV

PER CENT OF TEACHERS IN OHIO'S COUNTIES WHO TAUGHT ONE OR MORE CLASSES OF SCIENCE AND WHO OFFERED THEIR MOST RECENT DEGREE IN CERTAIN YEARS

Date of Degree	Per cent		
	Men	Women	Total
1950	18.0	10.5	17.0
1949	16.6	9.5	15.6
1948	9.08	9.0	9.07
1947	4.22	3.5	4.12
1946	2.55	3.0	2.6
1945	0.87	3.5	1.24
1940-44	12.3	15.5	13.5
1935-39	14.5	12.5	14.25
1930-34	11.5	15.5	12.1
1925-29	5.57	12.5	6.52
1920-24	2.47	4.5	2.75
Prior to 1920	1.27	0.5	1.17
Totals	100	100	100

Table XXIV shows in percentage form the same data which have been indicated in Table XXIII, and which were discussed earlier in this chapter.

TABLE XXV

DATE OF MOST RECENT DEGREE OFFERED BY TEACHERS OF OHIO'S EXEMPTED
VILLAGE SCHOOLS WHO TAUGHT ONE OR MORE CLASSES OF SCIENCE

Date of Degree	Men	Women	Total
1950	28	5	33
1949	24	1	25
1948	15	1	16
1947	7	0	7
1946	5	1	6
1945	4	1	5
1940-44	27	5	32
1935-39	26	1	27
1930-34	24	5	29
1925-29	17	2	19
1920-24	4	2	6
Prior to 1920	1	1	2
Totals	182	25	207

Tables XXV and XXVI indicate from point of numbers and also percentage wise the condition with regard to recency of latest degree for the exempted village teachers of Ohio. In all respects these two tables show closer similarity to the tables depicting the conditions in the county schools than to those illustrating conditions in the city schools.

Thus, since date of most recent degree has some relationship to the age of the teacher, it may be said safely that the exempted village teachers of science were much younger, as a group, than were the city teachers of science.

TABLE XXVI

PER CENT OF TEACHERS IN OHIO'S EXEMPTED VILLAGE SCHOOLS WHO
TAUGHT ONE OR MORE CLASSES OF SCIENCE OFFERING THEIR HIGHEST
DEGREE IN CERTAIN YEARS

Date of Degree	Per cent		
	Men	Women	Total
1950	15.4	20.0	15.94
1949	13.2	4.0	12.07
1948	8.35	4.0	7.72
1947	3.85	0.0	3.38
1946	2.74	4.0	2.9
1945	1.93	4.0	2.41
1940-44	14.9	20.0	14.0
1935-39	14.28	4.0	13.05
1930-34	13.2	20.0	14.0
1925-29	9.35	8.0	9.18
1920-24	1.93	8.0	2.9
Prior to 1920	0.55	4.0	0.96
Totals	100	100	100

TABLE XXVII

DATE OF MOST RECENT DEGREE OFFERED BY TEACHERS OF OHIO'S CITY
SCHOOLS WHO TAUGHT ONE OR MORE CLASSES OF SECONDARY SCIENCE

Date of Degree	Men	Women	Total
1950	43	3	46
1949	40	3	43
1948	27	6	33
1947	29	3	32
1946	17	1	18
1945	7	2	9
1940-44	91	19	110
1935-39	134	21	155
1930-34	126	30	156
1925-29	72	23	95
1920-24	44	19	63
Prior to 1920	67	21	88
Totals	697	151	848

Tables XXVII and XXVIII show that so far as can be told from these types of data, city teachers of science must be a much older group of teachers than the teachers of science in the county and exempted village schools. While teachers who had received their

most recent degree prior to 1920 were somewhat of a rarity in the smaller schools, the city schools counted more than one teacher in ten in this bracket.

Problems of in-service training of teachers probably would differ radically as among the various classes of schools, due to the great age and experience differential which shows up strongly in the comparison between city and county schools. In these matters, as has been stated earlier, the exempted village schools were more nearly like the county schools.

TABLE XXVIII

PER CENT OF TEACHERS IN OHIO'S CITY PUBLIC SCHOOLS WHO TAUGHT ONE OR MORE CLASSES OF SCIENCE OFFERING THEIR HIGHEST DEGREES IN CERTAIN YEARS

Date of Degree	Per cent		
	Men	Women	Total
1950	6.17	1.99	5.43
1949	5.73	1.99	5.07
1948	3.87	3.97	3.89
1947	4.16	1.99	3.78
1946	2.44	0.66	2.12
1945	1.05	1.33	1.06
1940-44	13.05	12.6	13.0
1935-39	19.2	13.9	18.28
1930-34	18.1	19.85	18.4
1925-29	10.35	15.25	11.2
1920-24	6.3	12.6	7.44
Prior to 1920	9.62	13.9	10.4
Totals	100	100	100

In the preceding tables (XXIII through XXVIII) the totals are somewhat different from the totals in the earlier tables due to the fact that teachers not having degrees of any kind have been omitted from these later tables.

The preceding figures may in some instances be compared with those obtained by Ferguson¹ for the school year 1947-48. In choosing what he believed to be a representative sampling of Ohio's schools, Ferguson determined certain factors about science teachers in these schools. He determined, for example, that at the time of his survey, and within the limits of accuracy imposed by his sampling, 4.3 per cent of Ohio's science teachers had no degree, that 68.9 per cent had their baccalaureate degree, and that 25.7 per cent had their master's with approximately 1.1 per cent having advanced to the doctoral level. While these figures are not quite comparable to the figures in this present study except in the case of those having no degree and those having doctorates; reasonably accurate comparisons may be made. The reason for this slight aspect of difference (at bachelor's and master's level) is due to the fact that the present survey includes teaching principals as teachers, whereas Ferguson listed the principals and administrators who were teaching some science in separate categories.

¹ Thomas C. Ferguson, op. cit.

The present study shows that somewhat less than one per cent of all of the teachers who were teaching any science in the public high schools of Ohio during 1950-51 had no degree. This figure represents a true decline in number of teachers not having a degree, since only 24 were discovered in the present survey covering every teacher of the state, whereas three years earlier, Ferguson had found sixteen in checking only 11 per cent of the teachers of the states. Thus during the few years between surveys, the number of teachers without degrees had dwindled to a considerable extent -- from over four per cent of all those teaching science to less than one per cent. This very large drop during the three-year period is quite significant in that it reflects the greater supply of teachers (at secondary level) who were released from colleges and universities in the years immediately following World War II. This conclusion is borne out further when we examine Tables XXIII and XXIV, noting the number of recently trained teachers in the rural schools.

Figures concerned with the number of teachers offering as their highest degree the bachelor's degree are roughly comparable, and probably would be very nearly comparable if they had been taken on the same basis. Thus Ferguson discovered that in his sampling, 68.9 per cent of the teachers held their bachelor's degree, while in the present study, the percentage approximates 66.5 per cent. At master's level, Ferguson found 25.7 per cent presenting this degree, while the present study indicated that about

31.6 per cent held a master's degree. Again, were the principals averaged in, the results probably would be comparable. At doctoral level, there are so few cases as to make the representativeness of any partial study open to question.

Thus the most significant item of difference in the two studies insofar as results are concerned, is that concerned with the teacher who had not completed an initial college degree. Here there appears to have been rather remarkable improvement during the three years of the post-war period covered by the interval between surveys.

Another item in Ferguson's study which is comparable to a similar item in the present study is the comparison between number of men and number of women teaching science. Ferguson found 24 per cent of the teachers of science to be women, whereas by 1950-51, the figure was down to 15 per cent. When the great number of men in the county schools having as the date of their most recent degree the years 1949 and 1950 is examined, it is easy to determine why the percentage of women dropped so radically during these few years. There is no evidence that Ferguson's study was not reasonably representative insofar as this factor is concerned, so it is likely that the change from 24 per cent to 15 per cent is probably very close to the actual difference as between the school year 1947-48 and the year 1950-51.

Experience of Science Teachers

The changing picture in the county schools is explained somewhat when we consider the great number of inexperienced and little-experienced individuals teaching in these schools during the school year 1950-51. Of 1476 teachers, some 223 were teaching their first year, while 192 were in their second year. Thus 28 per cent of all the county teachers who taught one or more classes of science were beginners or teachers with only a year of experience.

Information listed in the preceding paragraph tends to indicate that the great number of degrees obtained during the years 1950 and 1949 were not to any extent granted to teachers returning for a master's degree or a doctorate, but were largely baccalaureate degrees. While there is no direct evidence save for the fact that of the 415 teachers represented in the preceding paragraph only 41 were women, it is certain that the great majority of these teachers who swelled the ranks of the rural schools during these two years were returning GI's.

Close examination of these figures gives some indication concerning the probable fate of science teaching in the next few years should a national emergency call to service great numbers of those who served during World War II. In the exempted villages, much the same picture was presented, with 23.2 per cent of the teachers being either inexperienced or only having had one year of experience. In the cities, on the other hand, a quite different

situation prevailed, with only 6.64 per cent of the teachers in these brackets. Thus the post-war years appear to have resulted in a great influx of young teachers into the county schools, while the city schools have more nearly gone their accustomed way, less affected by the swell of GI's coming out of the colleges. Tables which deal with amounts of experience follow.

TABLE XXIX

NUMBER OF YEARS OF TEACHING EXPERIENCE OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHO TAUGHT ONE OR MORE CLASSES OF SCIENCE*

Years of Experience	Men	Women	Total
None	200	23	223
One	174	18	192
Two	104	20	124
Three	72	11	83
Four	54	11	65
Five	26	9	35
Six to Ten	122	35	157
Eleven to Fifteen	128	27	155
Sixteen to Twenty	139	24	163
Twenty-one to -five	111	10	121
Twenty-six to Thirty	74	11	85
Thirty-one to Forty	54	6	60
Over Forty	7	1	8
Totals	1265	206	1471

*

To these totals add five individuals for whom no data were given.

The very young teachers (in point of service) dominated the science teaching picture in the county schools. The modal teacher had taught no science prior to the year of the study. The median teacher in the county schools had taught for five years prior to the time of this study. Only a handful of teachers had taught more than forty years.

TABLE XXX

PER CENTS OF MEN AND OF WOMEN TEACHERS IN OHIO'S COUNTY SCHOOLS
HAVING TAUGHT VARIOUS NUMBERS OF YEARS

Number of Years	Per Cents		
	Men	Women	Total
None	15.81	11.16	15.16
One	13.75	8.73	13.05
Two	8.22	9.71	8.43
Three	5.69	5.34	5.64
Four	4.27	5.34	4.42
Five	2.05	4.37	2.38
Six to ten	9.64	17.00	10.67
Eleven to Fifteen	10.12	13.10	10.53
Sixteen to Twenty	10.99	11.65	11.08
Twenty-one to -five	8.77	4.85	8.22
Twenty-six to Thirty	5.85	5.34	5.78
Thirty-one to Forty	4.27	2.91	4.07
Over Forty	0.55	0.55	0.54
Totals	100	100	100

TABLE XXXI

NUMBER OF YEARS OF TEACHING EXPERIENCE OF TEACHERS IN OHIO'S
EXEMPTED VILLAGE SCHOOLS WHO WERE TEACHING ONE OR MORE CLASSES
OF SCIENCE

Number of Years	Men	Women	Total
None	24	5	29
One	18	1	19
Two	17	2	19
Three	7	0	7
Four	6	0	6
Five	8	1	9
Six to Ten	15	5	20
Eleven to Fifteen	21	1	22
Sixteen to Twenty	16	3	19
Twenty-one to -five	26	4	30
Twenty-six to Thirty	17	2	19
Thirty-one to Forty	7	1	8
Over Forty	0	0	0
Totals	182	25	207

*

To preceding totals and one individual for whom data were incomplete.

Statistically, the teachers in the exempted village schools were quite close to the teachers in the county schools in point of number of years of experience. No exempted village teacher of

science had been teaching for more than forty years, while only fourteen per cent were beginning teachers as compared with fifteen per cent for the county schools. Although the actual number was small, percentagewise the exempted village women teachers furnished the largest number of beginning teachers, with five of twenty-five who were teaching for the first time during the school year 1950-51.

TABLE XXXII

PER CENT OF MEN AND OF WOMEN IN OHIO'S EXEMPTED VILLAGE SCHOOLS HAVING TAUGHT VARIOUS NUMBERS OF YEARS (SCIENCE TEACHERS ONLY)

Number of Years	Per Cent		
	Men	Women	Total
None	13.2	20.00	14.00
One	9.90	4.0	9.20
Two	9.35	8.0	9.2
Three	3.85	0.0	3.38
Four	3.30	0.0	2.9
Five	4.4	4.0	4.35
Six to Ten	8.25	20.0	9.65
Eleven to Fifteen	11.52	4.0	10.6
Sixteen to Twenty	8.8	12.0	9.18
Twenty-one to -five	14.3	16.0	14.5
Twenty-six to Thirty	9.35	8.0	9.2
Thirty-one to Forty	3.85	4.0	3.86
Over Forty	0.00	0.0	0.00
Totals	100	100	100

TABLE XXXIII

NUMBER OF YEARS OF TEACHING EXPERIENCE OF TEACHERS IN OHIO'S
CITIES WHO WERE TEACHING ONE OR MORE CLASSES OF SECONDARY
SCIENCE

Number of Years	Men	Women	Total
None	22	2	24
One	30	3	33
Two	25	4	29
Three	14	3	17
Four	12	1	13
Five	14	3	17
Six to Ten	49	10	59
Eleven to Fifteen	72	10	82
Sixteen to Twenty	114	13	127
Twenty-one to -five	124	19	143
Twenty-six to Thirty	104	31	135
Thirty-one to Forty	110	48	158
Over Forty	16	4	20
Totals	706	151	857

*

To the preceding totals add three individuals for whom data were incomplete.

A comparison of Tables XXXIII and XXXIV with the four tables preceding them shows in close detail the age differential which exists among the teachers in the various categories of secondary schools in Ohio. Together with the information relating to recency of degree, the information given herewith, which concerns number of years of teaching experience indicates clearly the fact that students in county schools receive their science education from teachers who not only are younger, but who also are much more recently schooled.

TABLE XXXIV

PER CENT OF MEN AND OF WOMEN SCIENCE TEACHERS IN OHIO'S PUBLIC SECONDARY SCHOOLS (CITY) HAVING TAUGHT VARIOUS NUMBERS OF YEARS

Number of years	Per Cent		
	Men	Women	Total
None	3.11	1.35	2.80
One	4.25	1.99	3.84
Two	3.54	2.65	3.38
Three	1.98	1.99	1.98
Four	1.70	0.67	1.52
Five	1.98	1.99	1.98
Six to Ten	6.95	6.70	6.88
Eleven to Fifteen	10.20	6.70	9.58
Sixteen to Twenty	16.13	8.62	14.82
Twenty-one to -five	17.55	12.60	16.70
Twenty-six to Thirty	14.7	20.50	15.75
Thirty-one to Forty	15.56	31.80	18.41
Over Forty	2.26	2.65	2.34
Totals	100	100	100

Resume of Training and Experience

Before data pertaining to average number of years of experience and average amounts of training were determined, certain additional tables were prepared in order to permit a view of the state's teachers, regardless of their situation in rural, exempted village, or city schools. Accordingly, the following tables have been presented to indicate the picture as a whole.

TABLE XXXV

DEGREES OFFERED BY OHIO'S PUBLIC SECONDARY TEACHERS WHO WERE
TEACHING AT LEAST ONE CLASS OF SCIENCE

Degree	Men	Women	Total
None	19	5	24
Bachelor of Science	761	129	890
Bachelor of Science in Education	263	48	311
Bachelor of Arts	391	103	494
<u>Total Bachelor's</u>	<u>1415</u>	<u>280</u>	<u>1695</u>
Master's	714	94	808
Doctor's	4	2	6
Totals	2152	381	2533*

* The above totals do not include ten men and one women for whom records were not complete.

In seeking comparative data between Ohio and Nebraska, reference has been made to Engel's study¹ discussed earlier. Whereas in Ohio, as shown by Table XXXVI, almost 32 per cent of the teachers of science held master's degrees, in Nebraska two years earlier, only 15 per cent, or less than half as many, percentagewise, held the master's degree. Comparison between conditions in Ohio and those discovered in Louisiana by Lee² among the Negro teachers of that state are almost impossible to make because of the vast difference between the two groups in point of professional training.

A comparison of the training offered by Ohio teachers of science in comparison with that offered by Indiana teachers has been made possible by reference to the study made by Pontius.³ Whereas in 1948, some 91.4 per cent of the Indiana teachers held their baccalaureate degrees, in Ohio the percentage in 1950-51 was more than 99 per cent.

Pruitt's study,⁴ made some years earlier, showed a fairly large group of Oklahoma teachers with no college degree.

DeLoach⁵ found conditions concerning recency of training of Alabama chemistry teachers which corresponded roughly with those found in Ohio.

¹ Marion Engel, op. cit.

² J. Warren Lee, op. cit.

³ John Pontius, op. cit.

⁴ Clarence Pruitt, op. cit.

⁵ Will Scott DeLoach, op. cit.

TABLE XXXVI

PER CENT OF MEN AND WOMEN SCIENCE TEACHERS IN OHIO'S PUBLIC
SECONDARY SCHOOLS WHO OFFERED VARIOUS SCHOLASTIC DEGREES

Degree	Per Cent		
	Men	Women	Total
None	0.88	1.31	0.95
Bachelor of Science	35.36	33.86	35.14
Bachelor of Science in Education	12.22	12.60	12.28
Bachelor of Arts	18.17	27.04	19.50
<u>Total Bachelors</u>	<u>65.75</u>	<u>73.50</u>	<u>66.92</u>
Master's	33.64	24.67	31.90
Doctor's	0.19	0.52	0.23
Totals	100	100	100

TABLE XXXVII

DATES OF MOST RECENT DEGREES OFFERED BY OHIO'S PUBLIC SECONDARY
TEACHERS WHO WERE TEACHING ONE OR MORE CLASSES OF SCIENCE

Date of Degree	Men	Women	Total
1950	297	29	326
1949	272	23	295
1948	156	25	181
1947	89	10	99
1946	54	8	62
1945	22	10	32
1940-44	284	55	339
1935-39	342	47	389
1930-34	295	66	361
1925-29	159	50	209
1920-24	79	30	109
Prior to 1920	84	23	107
Totals	2133	376	2509

TABLE XXXVIII

PER CENT OF MEN AND WOMEN SCIENCE TEACHERS IN OHIO'S PUBLIC
SECONDARY SCHOOLS OFFERING THEIR DEGREES IN CERTAIN YEARS

Date of Degree	Per Cent		
	Men	Women	Total
1950	13.92	7.71	12.99
1949	12.75	6.12	11.76
1948	7.31	6.65	7.21
1947	4.17	2.66	3.95
1946	2.53	2.13	2.47
1945	1.03	2.66	1.27
1940-44	13.31	14.62	13.50
1935-39	16.03	12.50	15.49
1930-34	13.83	17.55	14.38
1925-29	7.45	13.30	8.32
1920-24	3.70	7.98	4.33
Prior to 1920	3.94	6.12	4.25
Totals	100	100	100

Tables XXXVII and XXXVIII have presented the totals for the State of Ohio of numbers and per cents of science teachers who have received their most recent degrees during certain years or during certain intervals of time. More than one teacher in every twenty-five has not received a degree since prior to 1920 -- in many cases, presumably has not been in any school or college of education, since that date. Most of these teachers were in the city schools, many of them in the larger city schools.

TABLE XXXIX

NUMBER OF YEARS OF EXPERIENCE POSSESSED BY SCIENCE TEACHERS IN
OHIO'S PUBLIC SECONDARY SCHOOLS

Number of Years	Men	Women	Total
None	246	30	276
One	222	22	244
Two	146	26	172
Three	93	14	107
Four	72	12	84
Five	48	13	61
Six to Ten	186	50	236
Eleven to Fifteen	221	38	259
Sixteen to Twenty	269	40	309
Twenty-one to -five	261	33	294
Twenty-six to Thirty	195	44	239
Thirty-one to Forty	171	55	226
Over Forty	23	5	28
Totals	2153	382	2535

Probably the most striking detail in the preceding table, Table XXXIX, is the fact that the experience curve is skewed so sharply in the direction of the inexperienced and little-experienced teacher. This factor alone is somewhat indicative of the extent to which the schools of the state were handicapped during the war years, when positions were found so readily for such a great influx of new teachers in the years immediately following the war.

TABLE XL

PER CENTS OF SCIENCE TEACHERS IN OHIO'S PUBLIC SECONDARY SCHOOLS
WHO HAD TAUGHT VARIOUS NUMBERS OF YEARS

Number of Years	Per Cent		
	Men	Women	Total
None	11.42	7.85	10.88
One	10.31	5.76	9.62
Two	6.78	6.81	6.78
Three	4.32	3.66	4.22
Four	3.34	3.14	3.31
Five	2.23	3.40	2.40
Six to Ten	8.64	13.09	9.34
Eleven to Fifteen	10.27	9.95	10.22
Sixteen to Twenty	12.49	10.47	12.19
Twenty-one to -five	12.12	8.63	11.59
Twenty-six to Thirty	9.05	11.52	9.43
Thirty-one to Forty	7.94	14.39	8.91
Over Forty	1.07	1.31	1.10
Totals	100	100	100

While further sections of this report indicate that there are certain areas of doubt with regard to the adequacy of training in Ohio's secondary teachers of science, the foregoing tables indicate that so far as the degree itself is concerned, practically all of Ohio's science teachers were within the requirement. The number of teachers who were teaching in this field without a degree appears to have taken a decided drop since the end of World War II, according to comparison with the results obtained by Ferguson, and which were quoted earlier.

Figures have been posted in the preceding tables to show that in general, the rural teacher of science was much younger in point of years taught, and had been to school much more recently than had his city counterpart. Exempted village teachers tended to be between the extremes, but in general leaned a little more closely toward the situation of the rural teachers.

Comparisons of the various groups in the factors concerned with training and experience are offered in the following tables.

TABLE XLI

PER CENT OF MEN AND OF WOMEN SCIENCE TEACHERS IN THE VARIOUS TYPES OF SECONDARY SCHOOLS OF OHIO WHO HAD OBTAINED AT LEAST A MASTER'S DEGREE

Type of School	Per Cent		
	Men	Women	Total
County School	23.8	11.37	21.96
Exempted Village School	32.9	16.0	30.9
City School	50.59	45.7	49.87
Totals	33.83	25.19	32.13

The preceding table indicates that as between the lowest group in point of advanced degrees (the women teachers in the county systems) and the highest group (men teachers in the city systems) there was a considerable difference. Thus the city men offered approximately 4.45 times as many advanced degrees in comparison as did the women teachers in the county schools. One factor which influenced the very considerable difference between men teachers and women teachers in the county schools is that there was a considerable number of principals included among the men teachers in such schools, and these individuals tended to have advanced degrees to a greater extent than did non-supervisory personnel, according to Ferguson's study, referenced earlier. The median secondary teacher of science in Ohio had a bachelor's degree, and in every individual classification except that of men teachers in city systems, this same statement was true. The median man teacher of science in a public secondary school in an Ohio city had his master's degree.

Recency of Training

Recency of training has been indicated in Table XLII. This table indicates that the most recently trained teacher in Ohio in the science teaching area was the man teacher in the county school. The median in this group insofar as date of most recent degree is concerned was the man who received his degree in 1946.

The group which had its training dating furthest back is apparently the group of women teachers in cities who traced their median to the span of years between 1930 and 1934. For the State as a whole, the most-recent-degree median was, for men, the span of years from 1940 to 1944 and for women from 1935 to 1939. Because of the preponderance of men, the state-wide median year for latest degree was to be found in the 1940-1944 span.

Further details may be extracted from Table XLII.

TABLE XLII

REGENCY OF TRAINING OF MEDIAN SCIENCE TEACHERS IN THE VARIOUS CLASSES OF OHIO'S SECONDARY SCHOOLS AS JUDGED BY DATE OF MOST RECENT DEGREE

Type of School	Men	Women	Total
County School	1946	1940-44	1940-44
Exempted Village School	1940-44	1940-44	1940-44
City School	1935-39	1930-34	1935-39
Totals	1940-44	1935-39	1940-44

Another approach to the recency of training is predicated on determining data relative to the groups of teachers having received their latest degrees prior to some arbitrary date. In this study the arbitrary date selected was the year 1920. In comparing numbers of teachers having received their most recent degree prior to that time, very great differences were found. The group having the smallest number of pre-1920 degree-holders was the group of women science teachers of the rural schools, where only one out of two hundred held such a degree. On the other hand, the highest group in number was the city women teachers, where almost one teacher of seven had no degree attained since the 1920 date. Percentage-wise, there were almost 28 times as many women to be found in one group as in the other. This group of women city teachers held almost a one and one-half to one percentage lead over the nearest group, the city men, who ranked 9.62 per cent of their number among those who had not received any type of degree since 1920. The table follows:

TABLE XLIII

RANKING OF VARIOUS GROUPS OF OHIO'S SECONDARY SCIENCE TEACHERS
ACCORDING TO THE PERCENTAGE OF TEACHERS AMONG THEM WHO HAD NO
DEGREE AWARDED SINCE 1920

Type of School	Per Cent		
	Men	Women	Total
County School	1.27	0.50	1.17
Exempted Village School	0.55	4.00	0.96
City School	9.62	13.90	10.40
Totals	3.94	6.12	4.25

The preceding table indicates that over one out of every 25 Ohio teachers of secondary science had no degree granted since 1920.

Ferguson found in his survey that the median Ohio teacher of secondary science had taught some 12.8 years in toto with approximately seven of those years in the present position. The first of these figures agrees with the number of years determined in the present study, although no determination was made concerning the latter figure. Both in the exempted villages and in the counties, median years of experience for men and women teachers alike were to be found in the six-to ten-year bracket. In the cities, however, the median number of years of experience was, for men, from 21 to 25 years, while for women it was still longer, being from 26 to 30 years. Here then, is a real difference between the city schools and those of the smaller units. There is a very real difference between the teacher who has from six to ten years of experience and the one who has from 26 to 30 years of experience. This difference may have been accentuated since the close of the war and the time of this study, unfortunately Ferguson's study did not develop this point to the extent necessary to make comparison possible as between 1947 and 1950. Nevertheless, it is clear that in comparing teachers of science in the rural and exempted village schools on the one hand, and teachers of science in the city schools on the other hand, there was a considerable age differential, particularly when women teachers were considered.

The data concerning recency of training which were presented earlier were colored by the fact that in the rural schools there were so many more young teachers, percentage-wise, than in the cities, and in the cities we found a much greater percentage of older teachers, particularly older women.

These facts must be taken into account when we attempt to develop pre-service and in-service training programs which may be of greatest value in our schools both to the new teacher and to the mature and seasoned teacher of the city schools. Further data may be determined from the table given herewith.

TABLE XLIV

NUMBER OF YEARS TAUGHT BY MEDIAN TEACHERS OF SCIENCE IN THE THREE
TYPES OF OHIO SECONDARY SCHOOLS

Type of School	Median Man	Median Woman	Total
County School	6-10 years	6-10 years	6-10 years
Exempted Village School	6-10 years	6-10 years	6-10 years
City School	21-25 years	26-30 years	21-25 years
Totals	11-15 years	11-15 years	11-15 years

The median teacher of science in Ohio's public secondary schools was a man, taught in a county school system, he had a bachelor's

degree which he obtained between 1940 and 1944, he had taught more than eleven and less than fifteen years.

Semester Hours of Science Listed by Science
Teachers in Ohio's County Schools

Earlier sections of this chapter have shown the pertinent data relative to the degrees offered by Ohio's secondary science teachers. There are many facets, however, to the education of a science teacher, and the type and recency of degree possessed is only one of these. Perhaps more important are the amount and type of science training obtained in college, university, or teacher training school.

Even this information does not give a complete picture of the breadth or depth of education of the science teacher, since not all education is formal, and since the factors bearing on the total educational pattern are many and varied.

Nevertheless, the type and amount of science credit obtained in the post-secondary institution is of some importance in judging the probable depth and breadth of scientific education of the teacher or prospective teacher. Because of the significance, data concerning this collegiate training have been included in tables as follows:

TABLE XLV

TOTAL NUMBER OF SEMESTER HOURS OF CREDIT IN ALL TYPES OF SCIENTIFIC SUBJECTS OFFERED BY OHIO'S COUNTY HIGH SCHOOL TEACHERS WHO TAUGHT AT LEAST ONE CLASS OF SCIENCE

Semester Hours of Credit	School Population			
	1-25 Pupils Per Grade	26-50 Pupil Per Grade	Over 50 per Grade	Totals
Zero	45	34	6	85
1 - 10	7	8	3	18
11 - 25	196	179	73	448
26 - 50	171	208	105	484
51 - 75	70	90	55	215
76 - 100	19	22	18	59
Over 100	14	13	4	31
Not listed	64	44	22	130
Totals	586	598	286	1470

Table XLV indicates that in the county schools of Ohio, some science was being taught by 85 individuals who had no formal training of any kind in science. While this percentage is not high considering the fact that there were 1470 teachers represented, yet the fact remains that all of these individuals were teaching classes of science and that in our county schools we had the pupils of 85

teachers being taught by persons who had no formal science training of any kind. Additionally, there were 18 such teachers who had ten or less semester hours of science, and 448 who had 25 or less hours of science.

Similar results were indicated in listing the number of semester hours of science offered by teachers in the major area of their science teaching. The following table, Table XLVI, indicates these quantities. It is interpreted as follows: If a teacher whose major area of teaching is in the field of science had twelve hours of physics, he has been listed in the "11 - 15" bracket of the Table. This listing holds regardless of whether he was a person devoting the major part of his time to the teaching of science subjects. For example, suppose that the teacher referred to in the preceding sentences were teaching mathematics during the major portion of the day, but also taught a class or two of physics, he would, in this table, be listed as a physics teacher. On the other hand, a person who taught five classes of biology and one class of physics would be listed hereon as a biology teacher for purpose of determining major area of teaching.

As may be expected, the total number of individuals in the "zero" category is larger in Table XLVI than in the preceding table, because some individuals are teaching a science for which they have had no preparation in terms of college courses even though they have had courses in certain other sciences. Some, for example, are teaching chemistry with no credit in the subject while they do present

some credit in physics or biology.

TABLE XLVI

NUMBER OF SEMESTER HOURS OF SCIENCE LISTED BY 1470 COUNTY TEACHERS
OF OHIO IN THE MAJOR AREA OF SCIENCE TEACHING

Semester Hours	School Population			Totals
	1 - 25 Pupils per Grade	26 - 50 Pupils per Grade	Over 50 per Grade	
Zero	54	47	9	110
1 - 5	0	0	0	0
6 - 10	24	23	6	53
11 - 15	70	54	22	146
16 - 30	175	199	89	463
31 - 50	96	109	79	284
51 - 75	53	76	39	168
Over 75	30	28	15	73
Undifferentiated Science*	84	62	27	173
Totals	586	598	286	1470

*

In these cases it was certain that the teacher had some science credit, but it was impossible to determine whether or not it was in the major area of teaching of the teacher.

Formal Training in the Various Sciences Offered by
County Teachers Whose Major Area of Science Teaching
Was in These Sciences

Some comparison of the relative degree of formal training offered by teachers in the various sciences has been offered in the following tabulation. Teachers whose major areas of science teaching were biology, chemistry, and physics, have been discussed in Tables XLVII, XLVIII, and XLIX. In no case do these tables indicate total number of semester hours of science offered by the teachers concerned. They indicate merely the number of hours of biological science offered by teachers whose major area of science teaching was biology, the number of hours of chemistry offered by county teachers whose major area of science teaching was chemistry, and similarly for physics. Because of the nature of general science, it has not been included in these tables, neither have any of the special science courses which were offered in the state in varying (but much lesser) number than the major sciences been included.

TABLE XLVII

SEMESTER HOURS OF CREDIT IN BIOLOGICAL SCIENCES OFFERED BY OHIO'S
COUNTY HIGH SCHOOL TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING
WAS BIOLOGY

Semester Hours	School Population			
	1 - 25 Pupils per Grade	26 - 50 Pupils per Grade	Over 50 per Grade	Totals
Zero	17	12	0	29
1 - 5	0	0	0	0
6 - 10	3	1	2	6
11 - 15	21	21	7	49
16 - 30	32	68	38	138
31 - 50	11	15	20	46
51 - 75	0	4	4	8
Over 75	0	2	1	3
Undifferentiated Science*	27	14	4	45
Totals	111	137	76	324

*

See similar note on preceding table.

Of 324 individuals in the county public high schools of Ohio, 29, or somewhat less than one of ten had no biology credit of any kind. The median biology teacher in these schools had from 16 to 30 semester hours of credit in biology. All of the individuals who had no biology credit were found in the two smaller categories of

county high schools. No biology teacher in any of the largest county high schools presented less than six hours of biology.

TABLE XLVIII

SEMESTER HOURS OF CHEMISTRY OFFERED BY OHIO'S COUNTY HIGH SCHOOL TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS CHEMISTRY

Semester Hours	School Population			
	1 - 25 Pupils per Grade	26 -50 Pupils per Grade	Over 50 per Grade	Totals
Zero	2	2	1	5
1 - 5	0	0	0	0
6 - 10	3	3	1	7
11 - 15	5	7	3	15
16 - 30	8	9	6	23
31 - 50	5	1	1	7
51 - 75	0	0	0	0
Over 75	0	3	0	3
Undifferentiated Science	11	5	5	21
Totals	34	30	17	81

Five county teachers whose major area of science teaching was in chemistry presented no chemistry credit, insofar as could be

determined from their records. Again, most of the teachers who had no credit, or were very weak in terms of number of hours of credit, were in the smaller county schools. The large county schools appeared to have teachers who were better prepared from the standpoint of number of hours of credit in the science being taught.

It is rather astonishing that in the subject of physics, which is certainly an area which requires rather careful preparation if the individual is to master the work, there were no fewer than 25 individuals teaching the course who had no preparation in the subject. This accounted for almost one of every seven teachers in the county schools whose major area of science teaching was in physics. Only two teachers whose major area was in physics reported more than 30 semester hours in this subject.

TABLE XLIX

SEMESTER HOURS OF PHYSICS OFFERED BY OHIO'S COUNTY HIGH SCHOOL TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS PHYSICS

Semester Hours	School Population			
	1 - 25 Pupils per Grade	26 - 50 Pupils per Grade	Over 50 per Grade	Totals
Zero	11	13	1	25
1 - 5	0	0	0	0
6 - 10	16	15	2	33
11 - 15	20	11	10	41
16 - 30	20	14	10	44
31 - 50	0	0	1	1
51 - 75	0	1	0	1
Over 75	0	0	0	0
Undifferentiated Science	17	18	5	40
Total	84	72	29	185

Preparation in Professional Education

Examination of the data contained in Ohio's high school principals' annual reports indicated that there was no ready way of determining a complete listing of all of the educational courses offered by all of Ohio's teachers of science. It was, however, readily possible to obtain a picture of the total amount of such work offered by Ohio's teachers. While an abundance of such credit may not indicate with certainty that teachers have had course experiences which are desirable for secondary teachers, a paucity of such course material is at least significant.. It may be assumed that in most cases the first 15 hours of such credit offered by teachers is the 15 hours required by regulation of the state department of education. Those who offered less, appeared to be, for the most part, older teachers and teachers who were teaching on temporary certificates. Not in all cases was it possible to determine amounts of such credit from principals' reports. These cases have been listed under an appropriate category in the table.

TABLE L

SEMESTER HOURS OF PROFESSIONAL EDUCATION OFFERED BY OHIO'S
COUNTY HIGH SCHOOL TEACHERS WHO TAUGHT ONE OR MORE CLASSES
OF SCIENCE

Semester Hours	School Population			
	1 - 25 Pupils per Grade	26 - 50 Pupils per Grade	Over 50 per Grade	Totals
Zero	3	1	0	4
1 - 10	1	3	2	6
11 - 20	113	89	36	238
21 - 30	210	225	120	555
31 - 50	149	153	79	381
51 - 75	61	75	34	170
76 - 100	9	6	4	19
Over 100	4	1	0	5
Not Listed	36	45	11	92
Totals	586	598	286	1470

It has not been possible to determine much concerning the suitability of professional educational experiences of science teachers in Ohio's county high schools. Percentage-wise, only ten teachers presented less than ten semester hours of professional educational credit, whereas almost 200 of the 1470 presented more than 50 hours of credit.

Formal Science Training of Exempted Village Science Teachers

Tables have been prepared which illustrate the same types of data concerning exempted village teachers which were presented earlier concerning county teachers. Thus the following table, Table LI is similar to Table XLV, etc.

TABLE LI

SEMESTER HOURS OF CREDIT IN ALL TYPES OF SCIENTIFIC SUBJECTS
OFFERED BY OHIO'S EXEMPTED VILLAGE TEACHERS WHO TAUGHT AT
LEAST ONE CLASS OF SCIENCE

Semester Hours of Credit	Number of Teachers
Zero	11
1 - 10	0
11 - 25	49
26 - 50	84
51 - 75	42
76 - 100	10
Over 100	9
Not Listed	2
Totals	207

In the exempted village schools, eleven teachers of 207 were teaching at least one class of science each with no science preparation of any type. While this number is not so large, percentage-wise, as the comparable figure from the county high schools, it still means that in Ohio's exempted villages, one teacher of science in every 20 was teaching in an area for which he had no preparation.

TABLE LII

NUMBER OF SEMESTER HOURS OF SCIENCE LISTED BY 207 EXEMPTED VILLAGE TEACHERS OF OHIO IN THEIR MAJOR AREA OF SCIENCE TEACHING

Semester Hours of Credit	Number of Teachers
Zero	15
1 - 5	0
6 - 10	5
11 - 15	28
16 - 30	68
31 - 50	44
51 - 75	20
Over 75	7
Undifferentiated Science*	20
Totals	207

*

Impossible to determine the subject category in which the training was offered.

Four teachers in the exempted villages had no science credit in the science area in which they were doing the major portion of their science teaching in addition to the eleven who had no science credit at all. The close observer may note that only eight teachers have been listed in Tables LIII - IV as having no preparation in their major area of science teaching, and may question the number given in Table LII. The difference occurs because of the fact that no separate table has been arranged for the general science teachers. Seven of the teachers having no science credit at all were carrying out the major part of their science work in the field of general science.

TABLE LIII

SEMESTER HOURS OF BIOLOGICAL SCIENCES OFFERED BY EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN BIOLOGY

Semester Hours of Credit	Number of Teachers
Zero	7
1 - 5	0
6 - 10	0
11 - 15	2
16 - 30	30
31 - 50	18
51 - 75	6
Over 75	1
Undifferentiated Science	6
Totals	70

TABLE LIV

SEMESTER HOURS OF CHEMISTRY OFFERED BY OHIO'S EXEMPTED VILLAGE
TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS CHEMISTRY

Semester Hours of Credit	Number of Teachers
Zero	0
1 - 5	0
6 - 10	3
11 - 15	11
16 - 30	7
31 - 50	4
Undifferentiated Science	6
Total	31

TABLE LV

SEMESTER HOURS OF PHYSICS OFFERED BY OHIO'S EXEMPTED VILLAGE
TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN PHYSICS

Semester Hours of Credit	Number of Teachers
Zero	1
1 - 5	0
6 - 10	1
11 - 15	10
16 - 30	9
31 - 50	1
51 - 75	1
Undifferentiated Science	6
Totals	29

TABLE LVI

SEMESTER HOURS OF PROFESSIONAL EDUCATION OFFERED BY 207 EXEMPTED
VILLAGE TEACHERS OF SCIENCE

Semester Hours of Credit	Number of Teachers
Zero	2
1 - 10	0
11 - 20	16
21 - 30	77
31 - 50	59
51 - 75	41
76 - 100	4
Not listed in amount	8
Total	207

In general, conditions with regard to number of semester hours of professional education credit differed little between the county schools and the exempted villages. While two offered no such credit, only these two had less than eleven hours. By and large, the number of credit hours offered was fairly high, but no estimate has been made concerning the effectiveness of the experiences gained therein.

Formal Training of Ohio's City Science Teachers

It was possible to assemble data concerning the formal training of Ohio's city high school teachers of science similar in every way to the items previously presented concerning Ohio's county and exempted village teachers. These data have been assembled in the following tables which give the same type of information as the earlier tables of this chapter, Tables XLV through LVI.

TABLE LVII

SEMESTER HOURS IN ALL TYPES OF SCIENTIFIC SUBJECTS OFFERED BY
864 OHIO CITY SCIENCE TEACHERS IN THE PUBLIC SECONDARY SCHOOLS

Semester Hours	School Population				Totals
	1-100 Pupils per Grade	101-200 Pupils per Grade	201-300 Pupils per Grade	Over 300 per Grade	
Zero	4	15	11	13	43
1 - 10	0	0	0	5	5
11- 25	19	36	28	68	151
26- 50	22	90	80	115	307
51- 75	19	63	47	81	210
76-100	5	21	22	44	92
Over 100	4	12	5	27	48
Not listed	0	0	0	8	8
Totals	73	237	193	361	864

The smallest schools have been castigated frequently for their inability or unwillingness to secure teachers who have been prepared in the subjects which they are supposed to teach. Nevertheless, even in the largest city schools of Ohio, there were some teachers who were teaching science subjects who had not one hour of formal education in any science subject. In the largest schools this figure was 13 or about one teacher in every 30 in this category. It is likely that this situation may be more serious in the city at least so far as the individual teacher is concerned because of the fact that a science teacher in a city school of the pupil population represented is likely to be facing many more pupils in science in the course of a day than is the teacher in the small county school.

TABLE LVIII

SEMESTER HOURS OF SCIENCE LISTED BY 864 OHIO CITY TEACHERS OF SCIENCE IN THE AREA OF THEIR MAJOR SCIENCE TEACHING EFFORT

Semester Hours	School Population				Totals
	1-100 Pupils per Grade	101-200 Pupils per Grade	201-300 Pupils per Grade	Over 300 per Grade	
Zero	4	20	13	17	54
1 - 5	0	1	0	1	2
6 - 10	1	4	3	8	16
11 - 15	4	7	9	25	45
16 - 30	31	72	51	92	246
31 - 50	16	58	48	76	198
51 - 75	10	29	20	63	122
Over 75	2	19	12	19	52
Undifferen- tiated Science	5	27	37	60	129
Totals	73	237	193	361	864

Altogether, there were 43 teachers of 864 in the city systems who were teaching some science with no formal science preparation on record.

In addition to the 43 city teachers who presented no science credit, there were 11 more who had no credit in their major area of science teaching. Additionally, there were 18 more who presented from one to ten hours of such credit, and 45 who had less than 16 semester hours. These figures are from the city schools -- the schools which by and large are wealthier, have higher salary schedules, and have better opportunity to have first choice in obtaining graduates of the teacher-education institutions.

TABLE LIX

SEMESTER HOURS OF BIOLOGICAL SCIENCES OFFERED BY OHIO'S CITY TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN BIOLOGY

Semester Hours	School Population				Totals
	1-100 Pupils per Grade	101-200 Pupils per Grade	201-300 Pupils per Grade	Over 300 per Grade	
Zero	1	5	5	6	17
1 - 5	0	0	0	0	0
6 - 10	0	3	0	3	9
11 - 15	2	3	3	9	17
16 - 30	6	26	25	34	91
31 - 50	9	21	19	22	71
51 - 75	3	5	7	25	40
Over 75	1	3	5	11	20
Undifferen- tiated Science	3	10	9	15	34
Totals	25	76	73	125	299

TABLE LX

SEMESTER HOURS OF CHEMISTRY OFFERED BY OHIO'S CITY HIGH SCHOOL
TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN CHEMISTRY

Semester Hours	School Population				Totals
	1-100 Pupils per Grade	101-200 Pupils per Grade	201-300 Pupils per Grade	Over 300 per Grade	
Zero	1	5	2	1	9
1 - 5	0	0	0	0	0
6 - 10	2	0	0	3	5
11 - 15	0	2	1	6	9
16 - 30	9	14	6	15	44
31 - 50	2	12	10	14	38
51 - 75	0	2	2	12	16
Over 75	0	0	0	0	0
Undifferen- tiated Science	1	6	12	12	31
Totals	15	41	33	63	152

Conditions in Ohio's cities were well illustrated in Tables LIX and LX which concerned the number of semester hours in biological sciences offered by biology teachers and of chemistry offered by chemistry teachers. In both cases not only were there several teachers who offered no credit in their major area of teaching, there were also quite a number who offered only a very limited amount of such credit. Fewer teachers had a large number

of hours in chemistry than was the case for biology.

TABLE LXI

SEMESTER HOURS OF PHYSICS OFFERED BY OHIO'S CITY HIGH SCHOOL
TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN THE AREA OF
PHYSICS

Semester Hours	School Population				
	1-100 Pupils per Grade	101-200 Pupils per Grade	201-300 Pupils per Grade	Over 300 Pupils per Grade	Totals
Zero	0	1	1	3	5
1 - 5	0	0	0	0	0
6 - 10	0	1	3	4	8
11 - 15	0	2	4	6	12
16 - 30	3	7	8	15	33
31 - 50	1	2	2	9	14
51 - 75	0	3	1	2	6
Over 75	0	0	1	1	2
Undifferen- tiated Science	2	4	5	7	18
Totals	6	20	25	47	98

The picture with regard to physics teachers in the city schools is similar to that with the biology and chemistry teachers. It should be kept in mind that these teachers were not teachers who happened to be teaching one class or so of the science named, but are teachers who were teaching for a major portion of their science

teaching time in the subject. The five who were teaching physics with no formal physics preparation were all teachers whose major teaching area was in physics.

TABLE LXII

SEMESTER HOURS OF PROFESSIONAL EDUCATION OFFERED BY 864 CITY HIGH SCHOOL TEACHERS OF SCIENCE IN OHIO

Semester Hours	School Population				Totals
	1-100 Pupils Per Grade	101-200 Pupils per Grade	201-300 Pupils per Grade	Over 300 Pupils per Grade	
Zero	0	2	0	0	2
1 - 10	1	0	1	1	3
11 - 20	5	29	14	27	75
21 - 30	27	55	52	88	222
31 - 50	26	104	76	140	346
51 - 75	9	39	27	73	148
76 - 100	3	4	7	18	32
Over 100	0	3	4	5	12
Not listed	2	1	12	9	24
Totals	73	237	193	361	864

The situation with regard to professional education subjects differed little among the city teachers from the conditions found in the county and exempted village schools. By and large, the teachers who had their baccalaureate degrees presented a limited

amount of pedagogical credits, those with advanced degrees were much more likely to present preparation in excess of 30 semester hours. The greater prevalence of the master's degree in the city schools caused the median number of hours of educational subjects to be proportionately higher than in the county schools.

Summary of Formal Training

The following tables summarize the data presented in Tables XLV through LXII inclusive. They develop the information from the over-all state-wide aspect.

TABLE LXIII

TOTAL NUMBER OF SEMESTER HOURS OF CREDIT IN ALL TYPES OF SCIENTIFIC SUBJECTS OFFERED BY 2541 TEACHERS IN OHIO'S HIGH SCHOOLS WHO TAUGHT ONE OR MORE CLASSES IN SCIENCE

Semester Hours	Type of School			
	County Schools	Exempted Village	City Schools	Totals
Zero	85	11	43	139
1 - 10	18	0	5	23
11 - 25	448	49	151	648
26 - 50	484	84	307	848
51 - 75	215	42	210	467
76 -100	59	10	92	161
Over 100	31	9	48	88
Not listed	130	2	8	140
Totals	1470	207	864	2541

While comparisons with similar studies have shown that Ohio is in no worse case than many other states, and is in much better situation than some, the fact remains that of the 2541 teachers of science considered in the State of Ohio, 139 individuals had no formal post-secondary training of any kind in any science area. While this number may not be accounted as very large, it is a serious matter to the thousands of young people in the state who receive their science education from these untrained teachers.

TABLE LXIV

SEMESTER HOURS OF SCIENCE CREDIT LISTED BY 2541 OHIO TEACHERS OF SECONDARY SCIENCE IN THE MAJOR AREA OF THEIR SCIENCE TEACHING EFFORT

Semester Hours	Type of School			
	County Schools	Exempted Village	City Schools	Totals
Zero	110	15	54	179
1 - 5	0	0	2	2
6 - 10	53	5	16	74
11 - 15	146	28	45	219
16 - 30	463	68	246	777
31 - 50	284	44	198	526
51 - 75	168	20	122	310
Over 75	73	7	52	132
Undifferen- tiated Science	173	20	129	322
Totals	1470	207	864	2541

Conditions shown in Table LXIII are further borne out by the details given in Table LXIV. In addition to the 139 individuals who had no science credit of any kind, there were 40 others who had some post-secondary science credit, but none in the area in which they were doing their major science teaching.

TABLE LXV

SEMESTER HOURS IN BIOLOGICAL SCIENCES OFFERED BY 693 OHIO HIGH SCHOOL TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN BIOLOGY

Semester Hours	Type of School			
	County Schools	Exempted Villages	City Schools	Totals
Zero	29	7	17	53
1 - 5	0	0	0	0
6 - 10	6	0	9	15
11 - 15	49	2	17	68
16 - 30	138	30	91	259
31 - 50	46	18	71	135
51 - 75	8	6	40	54
Over 75	3	1	20	24
Undifferen- tiated Science	45	6	34	85
Totals	324	70	299	693

TABLE LXVI

SEMESTER HOURS IN CHEMISTRY OFFERED BY 264 OHIO HIGH SCHOOL
TEACHERS WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN CHEMISTRY

Semester Hours	Type of School			
	County Schools	Exempted Villages	City Schools	Totals
Zero	5	0	9	14
1 - 5	0	0	0	0
6 - 10	7	3	5	15
11 - 15	15	11	9	35
16 - 30	23	7	44	74
31 - 50	7	4	38	49
51 - 75	0	0	16	16
Over 75	3	0	0	3
Undifferen- tiated Science	21	6	31	58
Totals	81	31	152	264

TABLE LXVII

SEMESTER HOURS OF PHYSICS OFFERED BY 312 OHIO HIGH SCHOOL TEACHERS
WHOSE MAJOR AREA OF SCIENCE TEACHING WAS IN PHYSICS

Semester Hours	Type of School			
	County Schools	Exempted Villages	City Schools	Totals
Zero	25	1	5	31
1 - 5	0	0	0	0
6 - 10	33	1	8	42
11 - 15	41	10	12	63
16 - 30	44	9	33	86
31 - 50	1	1	14	16
51 - 75	1	1	6	8
Over 75	0	0	2	2
Undifferentiated Science	40	6	18	64
Totals	185	29	98	312

The numbers of teachers in Ohio who were teaching a major portion of their time in the areas of biology, chemistry, and physics and who presented various amounts of post-secondary credit in science have been shown in Tables LXV, LXVI, and LXVII. The general median for number of semester hours offered by these teachers was from 16 to 30 hours. The difficulty with being satisfied with such a median is that while this number of hours of preparation gives at least some preparation in the subject, those who fall below the median

certainly are likely to be poorly prepared. The fact that the median of the state is within a certain bracket is cold comfort to the individual pupil who must receive his science instruction from a teacher who has had no preparation, and being unprepared is very likely to be little interested in the area and uncomfortable and unhappy in teaching it.

TABLE LXVIII

SEMESTER HOURS OF PROFESSIONAL EDUCATION CREDITS OFFERED BY 2541 HIGH SCHOOL TEACHERS OF OHIO WHO TAUGHT ONE OR MORE CLASSES OF SCIENCE

Semester Hours	Type of School			
	County Schools	Exempted Villages	City Schools	Totals
Zero	4	2	2	8
1 - 10	6	0	3	9
11 - 20	238	16	75	329
21 - 30	555	77	222	854
31 - 50	381	59	346	786
51 - 75	170	41	148	359
76 - 100	19	4	32	55
Over 100	5	0	12	17
Not listed	92	8	24	124
Totals	1470	207	864	2541

Professional educational credit varies little in amount, teacher by teacher, as between the small schools on the one hand and the large schools on the other. There were a few individuals in all classifications who had very little or no professional pedagogical work. On the other hand, there were many who had a reasonable amount, and quite a few who had a large amount. The city teachers had a larger percentage of their number who had extremely large amounts of credit of this type.

Breadth of Science Training

Factor one in the list of seventeen factors described earlier in this study had to do with the teacher's breadth of preparation and understanding in the sciences. This factor states in effect that a better learning situation will result, all other factors being equal, if the teacher has a considerable breadth as well as depth to his understanding of science. One of the items which bears on the breadth of understanding is the amount of training presented in various areas of science. The following data indicate that approximately one teacher of science out of every four presented formal college training in only one science. This number is in addition to the 139 (or almost five and one-half per cent) of Ohio's teachers of one or more classes of science who presented no formal training of any kind in post-secondary science. Thus,

approximately thirty per cent of Ohio's high school teachers of the category mentioned had either no science training at all or training in only one science. The data follow in Table LXIX.

TABLE LXIX

NUMBER OF HIGH SCHOOL TEACHERS TEACHING ONE OR MORE CLASSES OF SCIENCE WHO PRESENTED COLLEGE TRAINING IN ONLY ONE SUBJECT
MATTER BRANCH OF SCIENCE

Type of School	Total Number of Teachers	Number Having Preparation in Only One Science	Percentage of Total
County	1470	389	26.46
Exempted Village	207	47	22.70
City	864	208	24.07
Totals	2541	644	25.34

Formal Training in Specific Science Areas Offered
by County Science Teachers Who Taught One or More
Classes of the Various Sciences

A special series of tabulations was made of the county teachers of science because of the fact that in so many cases, the teacher concerned taught only one or two classes of a science, with perhaps the bulk of his day's work being in other subjects, science or non-

science as the case might be. This condition was not in effect to nearly so great an extent in either the exempted villages or the cities, hence, this type of tabulation did not extent to these classes of schools. In the larger school districts (represented for the most part by the exempted villages and cities), science teachers were more definitely teachers of science, and teachers tended to specialize more nearly in the teaching of one science.

In the rural areas, however, it seemed desirable to attempt to determine not only the type of preparation which was offered by the teacher in his major area of science teaching, but also the preparation he had in all of the sciences which he was required to teach, even though he taught only one class of the subject. Objection may be offered to this procedure in that a teacher teaching one class of biology can scarcely be called a biology teacher. Nevertheless, to the members of his class he is the biology teacher, and their progress depends to a considerable degree on his effectiveness as a biology teacher. Thus, these data have their place in a tabulation of science teaching conditions in the state. Because general science is general, tabulations have been made concerning the preparation of teachers in several branches of science, since many sciences contribute their bit to general science.

TABLE LXX

SEMESTER HOURS OF ALL TYPES OF SCIENCE OFFERED BY 802 OHIO COUNTY HIGH SCHOOL TEACHERS, EACH OF WHOM TAUGHT AT LEAST ONE CLASS OF GENERAL SCIENCE

Number of Hours Credit	School Enrollment			
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	Totals
Zero	23	13	1	37
1 - 10	4	4	00	8
11 - 20	67	56	15	138
21 - 30	55	63	21	139
31 - 40	36	41	20	97
41 - 50	31	39	26	96
51 - 60	27	38	21	86
61 - 70	19	21	11	51
71 - 80	12	14	9	35
81 - 90	8	8	2	18
91 - 100	5	2	4	11
Over 100	4	5	2	11
Amount not listed	36	26	13	75
Totals	327	330	145	802

Table LXX indicates that quite a number of general science teachers in the county schools have very little formal training in post-secondary science. In addition to the 37 teachers who had no such preparation, there were 146 who had less than 21 semester hours of all types of science. When it is considered that a little

knowledge about many sciences is necessary to a general science teacher, the amount of science presented by these 183 teachers appears to be very inadequate. The following tables show that not only is the amount inadequate, but in many cases the distribution of science credit is poor from the general science standpoint.

TABLE LXXI

SEMESTER HOURS OF UNDIFFERENTIATED SCIENCE OFFERED BY TEACHERS OF GENERAL SCIENCE IN OHIO'S COUNTY HIGH SCHOOLS (DATA FROM PRECEDING TABLE)

Number of Hours Credit	School Enrollment			
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	Totals
1 - 10	0	0	0	0
11 - 20	27	26	3	56
21 - 30	22	23	4	49
31 - 40	9	13	0	22
41 - 50	9	8	3	20
51 - 60	9	2	2	13
61 - 70	1	0	2	3
71 - 80	0	2	0	2
81 - 90	1	0	1	2
91 - 100	1	0	0	1
Over 100	1	0	0	1
Totals	80	74	15	169

In recording the preparation of the state's teachers of science, in certain cases it was impossible to determine from the reports of the principals just what sciences were indicated when semester hours of training were included. In these cases the science preparation was included under the term "undifferentiated science." The figures for the county general science teachers have been included in Table LXXI. While they probably would not alter the subject-preparation picture appreciably had they been in form such that they could have been classified properly, they were included for the sake of completeness.

TABLE LXXII

SEMESTER HOURS OF BIOLOGICAL SCIENCE OFFERED BY THE COUNTY TEACHERS
OF GENERAL SCIENCE LISTED IN TABLE LXX

Number of Hours Credit	School Enrollment			Totals
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	
Zero	67	80	39	186
1 - 10	4	7	2	13
11- 20	63	55	28	146
21- 30	36	44	18	98
31- 40	24	30	14	68
41- 50	9	8	9	26
51- 60	5	2	3	10
61- 70	1	2	1	4
71- 80	2	0	3	5
81- 90	0	1	0	1
91-100	0	0	0	0
Over 100	0	1	0	1
Totals	211	230	117	558

A good knowledge in the general area of the biological sciences is necessary for any teacher who hopes to teach general science successfully. So much of general science is concerned with living things. Yet of 802 county teachers of general science, 186 offered no post-secondary biological science credit of any kind. The generally poor showing in biological science is difficult to reconcile with any picture of good teaching in general science in the county schools of Ohio. Table LXXII does not indicate that the general science teachers of Ohio could have been broadly trained at least so far as the biological sciences were concerned.

Table LXXIII shows almost as sorry a picture in the case of the physical sciences. Of the 558 general science teachers in the county schools, for whom records were complete, 178 were teaching the subject with no physical science. Thus, from the two tables we see a picture of general science teaching which indicates that conditions cannot be good from the standpoint of having the subject taught by well prepared teachers. Many were teaching with no science credit at all. Thirty-five per cent of those whose records were complete were teaching with no biological science preparation, and almost as many with no preparation in the physical sciences.

TABLE LXXIII

SEMESTER HOURS OF PHYSICAL SCIENCE OFFERED BY THE COUNTY TEACHERS
OF GENERAL SCIENCE LISTED IN TABLE LXX

Number of Hours Credit	School Enrollment			
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	Totals
Zero	70	66	42	178
1 - 10	9	4	1	14
11 - 20	51	39	16	106
21 - 30	26	53	26	105
31 - 40	25	41	17	83
41 - 50	17	9	12	38
51 - 60	9	6	1	16
61 - 70	2	4	2	8
71 - 80	1	5	0	6
81 - 90	1	2	0	3
91 - 100	0	0	0	0
Over 100	0	1	0	1
Totals	211	230	117	558

TABLE LXXIV

SEMESTER HOURS OF EARTH SCIENCE OFFERED BY THE COUNTY TEACHERS
OF GENERAL SCIENCE LISTED IN TABLE LXX

Number of Hours Credit	School Enrollment			
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	Totals
Zero	206	220	111	537
1 - 10	0	2	0	2
11 - 20	2	3	3	8
21 - 30	2	3	2	7
31 - 40	1	2	1	4
Totals	211	230	117	558

TABLE LXXV

SEMESTER HOURS OF COLLEGE GENERAL SCIENCE OFFERED BY THE COUNTY
TEACHERS OF GENERAL SCIENCE LISTED IN TABLE LXX

Number of	School Enrollment			
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	Totals
Zero	183	212	93	488
1 - 10	1	1	1	3
11 - 20	8	12	7	27
21 - 30	6	7	5	18
31 - 40	8	2	3	13
41 - 50	4	5	7	16
51 - 60	1	0	1	2
61 - 70	0	0	0	0
71 - 80	0	0	0	0
81 - 90	0	1	0	1
Totals	211	230	117	558

Geology and the earth sciences seem to have been neglected almost completely by the county teachers of general science. Only 21 of 538 for whom there were records had any preparation at all in any of the earth sciences -- a negligible figure. Yet the well prepared teacher of general science needs to have wide knowledge about the earth and its structure.

If the teachers had given evidence that their basic weaknesses in preparation were offset by other types of preparation, the picture might seem less gloomy. For example, well-taught courses in general science in the teacher-preparatory school could aid in giving the teacher much of the background information which has been lost because of lacks in physical, biological, or earth sciences. Table LXXV indicates, however, that teachers did not present credit for college courses in general science except in widely scattered instances. While more of these teachers had taken college general science than had taken geology, the number was still quite small. Of the 558 teachers whose records were given, 488 offered no credit in college general science.

The general science teaching picture in the county schools reflects a long-term habit of administrators of letting "anyone" teach general science. As a consequence "anyone" was teaching it. More than any other area of science, general science has suffered at the hands of untrained teachers, if these tables may be considered representative.

TABLE LXXVI

TOTAL NUMBER OF SEMESTER HOURS OF CREDIT IN ALL SCIENCES OFFERED
BY COUNTY TEACHERS OF OHIO WHO TAUGHT ONE OR MORE CLASSES OF HIGH
SCHOOL BIOLOGY

Number of Hours Credit	School Enrollment			
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	Totals
Zero	18	10	0	28
1 - 10	1	3	2	6
11 - 20	64	59	27	150
21 - 30	47	53	26	126
31 - 40	25	36	11	72
41 - 50	22	40	15	77
51 - 60	19	30	15	64
61 - 70	10	16	10	36
71 - 80	5	10	7	22
81 - 90	5	6	3	14
91 - 100	3	2	2	7
Over 100	4	5	2	11
Amount of Science not Listed	33	20	8	61
Totals	256	290	128	674

TABLE LXXVII

NUMBER OF SEMESTER HOURS OF BIOLOGICAL SCIENCE OFFERED BY THE
COUNTY TEACHERS OF BIOLOGY LISTED IN TABLE LXXVI

Number of Hours Credit	School Enrollment			
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	Totals
Zero	36	19	7	62
1 - 10	5	7	2	14
11 - 20	67	94	38	199
21 - 30	36	67	29	132
31 - 40	25	27	19	71
41 - 50	9	9	9	27
51 - 60	4	5	2	11
61 - 70	1	2	2	5
71 - 80	1	1	4	6
81 - 90	0	2	0	2
91 - 100	0	0	0	0
Over 100	1	1	0	2
Totals	167	234	112	531

Table LXXVI indicates that of the 674 teachers in the county schools of Ohio who were teaching biology, 28 had no preparation in any post-secondary science. The following table, Table LXXVII shows that an additional 34, or a total of 62 altogether, had no post-secondary preparation in any biological science. More than half of the teachers had less than 21 semester hours of preparation in the biological sciences.

TABLE LXXVIII

NUMBER OF SEMESTER HOURS OF UNDIFFERENTIATED SCIENCE OFFERED BY THE COUNTY TEACHERS OF BIOLOGY LISTED IN TABLE LXXVI

Number of Hours Credit	School Enrollment			
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	Totals
1 - 10	0	2	0	2
11 - 20	13	5	1	19
21 - 30	13	12	0	25
31 - 40	6	7	0	13
41 - 50	2	7	2	11
51 - 60	2	3	3	8
61 - 70	0	0	1	1
71 - 80	0	0	1	1
81 - 90	0	0	0	0
91 - 100	1	0	0	1
Over 100	1	0	0	1
Totals	38	36	8	82

Even though many executive heads of county schools were somewhat careless in differentiating the various types of science credit offered by their teachers, even had all of the credit offered as "undifferentiated science" been in the field of biology, the picture would not have been changed radically. The 82 teachers who were in this category have had their semester hours of undifferentiated science listed in Table LXXVIII.

TABLE LXXIX

TOTAL NUMBER OF SEMESTER HOURS OF CREDIT IN ALL SCIENCES OFFERED
BY COUNTY TEACHERS OF OHIO WHO TAUGHT ONE OR MORE CLASSES OF HIGH
SCHOOL CHEMISTRY

Number of Hours Credit	School Enrollment			
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	Totals
Zero	1	0	0	1
1 - 10	0	0	0	0
11 - 20	12	9	4	25
21 - 30	18	24	10	52
31 - 40	14	20	13	47
41 - 50	8	19	14	41
51 - 60	9	14	13	36
61 - 70	7	11	5	23
71 - 80	3	9	5	17
81 - 90	2	0	0	2
91 - 100	1	1	4	6
Over 100	0	1	1	2
Amount of Science not Listed	10	11	7	28
Totals	85	119	76	280

People without formal training in post-secondary science were not found in the chemistry teaching field in the county schools. Only one such person was listed of the 280 teachers of chemistry. No other person was listed with less than eleven semester hours of science.

The median number of hours of science of this group of teachers was in the 41 - 50 semester hour-bracket, a fairly respectable showing, although 26 teachers had so little science as to make their preparation questionable.

TABLE LXXX

SEMESTER HOURS OF CHEMISTRY OFFERED BY THE COUNTY HIGH SCHOOL TEACHERS OF CHEMISTRY LISTED IN TABLE LXXIX

Number of Hours Credit	School Enrollment			
	1-25 perGrade	26-50 per Grade	Over 50 per Grade	Totals
Zero	1	3	3	7
1 - 10	14	5	7	26
11 - 20	28	48	26	102
21 - 30	8	18	14	40
31 - 40	3	6	5	14
41 - 50	1	1	2	4
51 - 60	2	2	1	5
61 - 70	1	1	0	2
Totals	58	84	58	200

TABLE LXXXI

SEMESTER HOURS OF UNDIFFERENTIATED SCIENCE OFFERED BY OHIO COUNTY
CHEMISTRY TEACHERS LISTED IN TABLE LXXIX

Number of Hours Credit	School Enrollment			
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	Totals
1 - 10	0	0	0	0
11 - 20	5	5	0	10
21 - 30	6	6	3	15
31 - 40	2	5	2	9
41 - 50	2	4	2	8
51 - 60	1	2	0	3
61 - 70	0	0	2	2
71 - 80	0	2	1	3
81 - 90	0	0	1	1
Totals	16	24	11	51

Only a few teachers of chemistry in Ohio were attempting to teach the subject without benefit of formal post-secondary courses in chemistry. However, many more than half of the teachers had less than 21 hours of chemistry at college level, and only eleven teachers of the 200 for whom records were complete had more than forty semester hours of chemistry.

TABLE LXXXII

TOTAL NUMBER OF SEMESTER HOURS OF CREDIT IN ALL SCIENCES OFFERED BY
COUNTY TEACHERS OF OHIO WHO TAUGHT ONE OR MORE CLASSES OF PHYSICS

Number of Hours Credit	School Enrollment			
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	Totals
Zero	7	3	0	10
1 - 10	2	1	0	3
11 - 20	29	18	8	55
21 - 30	31	37	13	81
31 - 40	35	37	11	83
41 - 50	28	32	17	77
51 - 60	20	23	11	54
61 - 70	15	19	10	44
71 - 80	9	7	5	21
81 - 90	3	2	0	5
91 - 100	4	2	4	10
Over 100	5	4	0	9
Amount of Science not listed	27	23	9	59
Totals	215	208	88	511

TABLE LXXXIIII

SEMESTER HOURS OF PHYSICS OFFERED BY THE COUNTY HIGH SCHOOL
TEACHERS OF PHYSICS LISTED IN TABLE LXXXII

Number of Hours Credit	School Enrollment			
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	Totals
Zero	19	16	4	39
1 - 10	42	37	10	89
11 - 20	63	77	38	178
21 - 30	18	12	12	42
31 - 40	0	5	3	8
41 - 50	1	1	0	2
51 - 60	1	2	0	3
Totals	144	150	67	361

Teachers of physics were not so well prepared in terms of formal post-secondary courses as were teachers of chemistry. More than one-third of these teachers either had no formal physics courses or had less than eleven semester hours of credit. Ten were teaching with no science credit of any kind at post-secondary level. Only five of the 361 for whom records were complete had more than 40 semester hours of preparation.

TABLE LXXXIV

SEMESTER HOURS OF UNDIFFERENTIATED SCIENCE OFFERED BY OHIO COUNTY
PHYSICS TEACHERS LISTED IN TABLE LXXXII

Number of Hours Credit	School Enrollment			
	1-25 per Grade	26-50 per Grade	Over 50 per Grade	Totals
1 - 10	0	0	0	0
11 - 20	12	4	3	19
21 - 30	7	12	0	19
31 - 40	8	9	1	18
41 - 50	2	7	1	10
51 - 60	2	3	4	9
61 - 70	3	0	2	5
71 - 80	0	0	1	1
81 - 90	0	0	0	0
91 -100	2	0	0	2
Over 100	1	0	0	1
Totals	37	35	12	84

Summary

1. Of the 2544 science teachers in Ohio during the school year 1950-51, 1270 were teaching in county schools, 183 in the exempted village schools, and 855 in county schools. Almost 85 per cent of these science teachers were men.
2. In the county schools, only a little more than 22 per cent of the teachers held master's degrees, while in the city schools, the modal degree was the master's. Exempted village schools were more like the county schools than the city schools in this respect.
3. Seventeen county teachers of science, and seven in the cities were teaching without a degree. In the cities, all of the individuals who were teaching without degrees had been teaching for many years.
4. More than 32 per cent of the county teachers of science had received their most recent degrees (and in most cases their only degree) in the two-year period immediately prior to the date of this study. Only a few more than one-tenth of the city teachers had received their most recent degree during this same period of time.
5. More than one-tenth of the city teachers of science had received their most recent degree at least 30 years prior to the time of this study, while in the county schools, the percentage on this item was only a little more than one per cent.
6. Half or more of the county teachers of science had received their most recent degrees since 1945, while more than half of the city teachers had received their degrees prior to 1940. In the exempted villages, the mid-point in terms of time of most recent degree was in the span of years from 1940 to 1944.
7. Because date of most recent degree is at least indicative in determining relative age and experience of teachers, this factor of itself gives a comparison which has considerable value in making determinations which are related to the recommendations of this study. Problems related to in-service education of teachers, for example, could be greatly different with a very young group of teachers than with a group of teachers who had many years of teaching experience.

8. A comparison of the results of Ferguson's study, undertaken in 1947-48, with the results of the present study, shows that in the post-war years there had been a very considerable real decline in the number of teachers of science who did not possess degrees. Other figures from Ferguson's study of science teachers in Ohio compared closely with similar figures determined from the data of this study, except that the percentage of women teachers of science as compared with men had shown a decline.
9. More than a fourth of Ohio's teachers of science in the county schools were teaching their first or second year of science at the time the data were collected for this study. The great majority of these young teachers were men, and probably represented the return of the "G.I.'s" to civilian occupation.
10. In the exempted villages, almost one teacher of every four either was inexperienced or had only one year of experience. In the cities, on the other hand, only about one teacher in fourteen was in this bracket so far as experience was concerned.
11. A relatively small number of county teachers of science had been teaching for more than forty years. No exempted village teacher had been teaching that long, while in the city schools, twenty teachers, or a little more than two per cent were teachers with more than forty years of experience.
12. Women teachers of science in Ohio possess, percentage-wise, fewer master's degrees than do men teachers. County teachers have less in comparison than do teachers in the cities or exempted villages. Exempted villages have something less than one-third of their teachers of science with master's degrees, while in the cities, almost one science teacher of every two has such a degree. Men teachers of science in the city schools were more likely to hold the master's degree than were any of the other groups of teachers. Women teachers in the county schools were least likely to possess the advanced degree.
13. The most recently trained teacher in the State of Ohio was the man teacher in the county school. The median man teacher of science in this category of school had received his most recent degree in 1946. The least recently trained teacher of science in Ohio was the woman teacher in the city school. The median woman teacher in the city classification had received her most recent degree in the span of years from 1930 to 1934.

14. The average teacher of science in both the county and exempted village schools has taught more than six and less than ten years. In the city schools, on the other hand, the average man teacher of science has taught from 21 to 25 years and the average woman has taught from 26 to 30 years.
15. The median teacher of science in Ohio's public high schools was a man, he taught in a county system, he had a bachelor's degree which he obtained during the span of years from 1940 to 1944, and he had taught more than eleven and less than fifteen years.
16. In the county schools of Ohio, during the school year 1950-51, science was being taught by 85 individuals who had no semester hours of college work in any science subject or area. There were 110 individuals (including the preceding 85) who offered no credit in their major area of science teaching. This figure represents almost one teacher of science of every fourteen in the county schools.
17. In the exempted village schools, 11 teachers of 207 had no preparation in any kind of science. Fifteen of the 207 had no preparation in the science area in which they were doing the major portion of their science teaching.
18. Forty-three teachers of science subjects in Ohio's city schools had no formal preparation in the science field. An additional 11, making a total of 54 had no preparation in the field of science in which the major teaching took place. Of the city teachers, 17 individuals who were teaching a major portion of their time in biology had no training in biological sciences, nine in chemistry had no chemistry and five in physics had no physics at all.
19. In all of Ohio's public schools, 139 individuals were teaching science subjects who had no post-secondary preparation in any science. An additional 40 were teaching science who had some post-secondary science credit, but none in the area of their major portion of science teaching.
20. Of all of Ohio's science teachers, approximately 25 per cent had preparation in only one science. This percentage is in addition to the five and one-half per cent who had no formal post-secondary science preparation of any kind. Thus, at least 30 per cent of Ohio's secondary science teachers could not have had broad preparation in the sciences, at least so far as their post-secondary formal preparation was concerned. In these matters, county high school teachers were not in appreciably worse case than were city teachers.

21. Teachers of general science in the county schools were found to be sadly deficient in preparation in biological science, with 35 per cent of those whose records were complete having no such preparation. The same situation prevailed in physical science, whereas in earth science, only about one per cent of the teachers presented any credit at all. College general science was offered by only 70 teachers of the 558 for whom there were complete records.
22. County teachers of the biological sciences were in somewhat better situation as regards preparation, chiefly because the preparation of the biology teacher does not require the infusion of so many different areas of science. Nevertheless, there is evidence that the biology teachers did not have any greater breadth of preparation than did the general science teachers. Of the biology teachers, 62 or almost one in eight had no formal post-secondary preparation in any biological science.
23. Teachers of chemistry in the county schools appeared to be somewhat better prepared in point of post-secondary science preparation than were teachers of biology. Several chemistry teachers, however, were teaching the subject without having had any college courses in chemistry.
24. Teachers of physics in the county schools were not well prepared if we use formal post-secondary preparation as a criterion. More than one-third of these teachers had either no formal physics preparation or less than eleven semester hours of preparation. Only five of 361 for whom records were complete presented more than 40 semester hours of physics.
25. In general, teachers of science in the county high schools of Ohio showed inadequate preparation in science; general science teachers showed great weaknesses in preparation in physical science areas, biological science, and particularly in the earth sciences.

Chemistry teachers, while not presenting as much post-secondary science preparation as might be desired, were in better situation than physics teachers.

Teachers in Ohio's schools of all categories were, as a group, somewhat weak in their science preparation. The most serious situation, however, is not the weakness of the median, but the fact that so many individuals were teaching who had practically no science preparation of any kind.

CHAPTER VI

PHYSICAL CONDITIONS UNDER WHICH THE SCIENCES WERE TAUGHT IN OHIO'S SCHOOLS

Factors 6, 15, and 16, all are concerned in one way or another with the physical environment in which science is taught. Factor 6 deals with the classroom aids, devices, etc.; factor 15 with the laboratory equipment, and factor 16 with the physical condition of the rooms themselves. Evidence concerning these factors has been obtained partly from the State Department of Education, partly from the teachers of Ohio themselves. It is likely that no two individuals would present the same opinion regarding the total suitability or non-suitability of a given room and its equipment for successful teaching of science. However, within the limits of teacher opinion and the opinion of the state school supervisors, a partial answer has been given which may be interpreted in the light of allowance for human judgment and human bias.

Certainly, the opinions of state supervisors of schools should not be taken too lightly in that they visit and compare one school with another, probably seeing conditions in more schools than any other individuals in the State of Ohio. Certainly, also, the opinions of teachers should not be discounted too greatly, since they are in their rooms day in and day out, year in and year out, and have the opportunity to view the limitations as well as the favorable items in their room environment.

In this chapter, the opinions of the state school supervisors are given. The data were presented by these individuals as a result of their most recent inspections as of December 1950, and some of the data were at that time at least two years old. Whether or not there was any considerable change during the two years is problematical, with very little change certain in most instances, since figures furnished by the teachers tended to show a very small average expenditure of money for laboratories and science rooms during that period.

Not all of the state's schools were represented in these evaluations, since some data were unusable. The following data show conditions in each science room rather than school by school. In all of the county schools except the larger ones, there was only one room represented. In the exempted village and city schools, however, the number tended to be greater than one.

The criterion used by the state department supervisors is, according to testimony from the state department, the suitability of the room and its equipment and materials for the purpose for which it is intended. Thus a room which might be marked satisfactory if used for a biology room alone might be marked as being unsatisfactory if it was required to be used also for chemistry and general science.

TABLE LXXXV

CONDITION OF LABORATORIES, APPARATUS, EQUIPMENT, AND SCIENCE
CLASSROOMS IN OHIO'S COUNTY SCHOOLS AS REPORTED BY THE HIGH
SCHOOL SUPERVISORS, 1948 - 1950

Enrollment per Grade	Rating					
	Excellent	Superior	Satisfactory	Fair	Poor	Total
1 - 25	0	4	134	163	61	362*
26 - 50	1	18	175	97	28	319*
Over 50	0	10	76	28	5	119*
Totals	1	32	385	288	94	800*

*

Reports include a few schools which have been consolidated since the time of the earlier reports.

TABLE LXXXVI

CONDITION OF LABORATORIES, APPARATUS, EQUIPMENT, AND SCIENCE CLASS-
ROOMS IN OHIO'S EXEMPTED VILLAGE SCHOOLS AS REPORTED BY THE HIGH
SCHOOL SUPERVISORS, 1948 - 1950

Enrollment per Grade	Rating					
	Excellent	Superior	Satisfactory	Fair	Poor	Totals
	0	12	48	13	3	76

TABLE LXXXVII

CONDITION OF LABORATORIES, APPARATUS, EQUIPMENT, AND SCIENCE
CLASSROOMS IN OHIO'S CITY HIGH SCHOOLS AS REPORTED BY THE OHIO
HIGH SCHOOL SUPERVISORS, 1948 - 1950

Enrollment per Grade	Rating					
	Excellent	Superior	Satisfactory	Fair	Poor	Totals
1 - 100	0	4	26	3	0	33
101 - 200	0	16	67	12	2	97
201 - 300	2	12	34	6	2	56
Over 300	5	23	40	3	0	71
Totals	7	55	167	24	4	257

Interpretation of Tables LXXXV - LXXXVII

Even a cursory glance at the three preceding tables will show that in general, the county schools were considered to be in much worse case than were the exempted village or city schools. The situation was particularly bad in the group of county schools having twenty-five or less pupils per grade. In these schools, in addition to quite a number which had no recognizable laboratory as such, more than three of every five (61.88 per cent) had a laboratory or science room which, together with its equipment and apparatus ranked less than satisfactory.

The percentage of schools having "less than satisfactory" facilities dropped rapidly as the population of the schools increased, with the other two classifications of rural schools having per cents of 39.18 and 27.73 respectively.

The somewhat larger schools represented by the exempted villages were in better case than was even the best group of county schools, having slightly more than one-fifth of its science rooms declared less than satisfactory.

No group of city schools had more than one of seven science facilities declared inadequate, and the largest group (in point of pupil population) had only one science facility of every twenty-five declared less than satisfactory.

State supervisors would be quick to direct attention to the fact that in schools having more than one science room, it is impossible always to get a clear picture of each individual science room from the state's composite report. In most schools, however, the general picture is rather close to the actual conditions extant in the school within the limits of human error.

How Well Equipped Were Science Rooms?

In addition to a general rating of science rooms, the state secondary school supervisors noted the presence or absence of certain items of equipment which are presumed to be of value in the teaching of science. These items are listed in the following tables. While their presence may or may not mean that they are

being used properly and to the best interests of a good learning situation in science, certainly their absence denotes definite lack of needed items.

One item which strikes the eye is the scarcity of micro-projectors in the small schools. These schools are the ones which are most likely to be without any (or at least many) microscopes, and the use of a single micro-projector could be of even greater value in schools of this type than in the schools which are better equipped with microscopes. Of 435 county schools listed, only 189 had micro-projectors, which almost certainly means that microscopic work was absent from the biology and general science learning situations in many of these schools. The larger schools, which presumably are in better position so far as microscopes are concerned also were in better position with regard to micro-projectors. There probably is some significance in these factors for the teacher-training institution. If the teacher in training can be made thoroughly familiar with the micro-projector, and if he can understand its small cost in comparison with the cost of the number of microscopes which it may partially replace, perhaps conditions could be more effective in the smaller science laboratories of the state.

Even a casual glance at the following tables will show the reviewer that the number of schools listed varies with the item under consideration. This variation occurs because not nearly

all of the supervisor's reports were complete. Some had certain items complete, others omitted, some were incomplete with regard to all of the items in the following tables. These tables were prepared using all of the data available on the reports. There is no evidence concerning the representativeness of the sampling.

TABLE LXXXVIII

NUMBER OF LABORATORIES AND SCIENCE ROOMS IN OHIO'S COUNTY SCHOOLS
EQUIPPED WITH CERTAIN TYPES OF FURNISHINGS, EQUIPMENT, AND APPARATUS,
AND NUMBER NOT SO EQUIPPED*

Equipment	Number Equipped	Number Not Equipped	Percentage Not Equipped
Teacher's Demonstration Desk	325	150	31.58
Water	466	16	3.32
Gas	369	101	21.49
Electricity	431	39	8.29
Shades	354	100	22.03
Opaque Projector	102	284	73.73
Motion Picture Equipment	383	48	11.14
Micro-projector	189	246	56.55
Models	115	300	72.29
Charts	406	61	13.06
Specimens	268	176	39.64
Aquariums	165	255	60.71
Germinating Beds	81	302	78.85

*

There were 485 schools included. In addition there were 24 county schools which were listed as having no laboratories or science rooms of any kind.

TABLE LXXXIX

NUMBER OF LABORATORIES AND SCIENCE ROOMS IN OHIO'S EXEMPTED VILLAGE SCHOOLS EQUIPPED WITH CERTAIN TYPES OF FURNISHINGS, EQUIPMENT, AND APPARATUS, AND NUMBER NOT SO EQUIPPED*

Equipment	Number Equipped	Number Not Equipped	Percentage Not Equipped
Teacher's Demonstration Desk	48	7	12.72
Water	54	0	0.00
Gas	53	0	0.00
Electricity	54	0	0.00
Shades	44	10	18.52
Opaque Projector	22	22	50.00
Motion Picture Equipment	45	5	10.00
Micro-projector	28	24	46.15
Models	32	18	36.00
Charts	51	5	8.93
Specimens	43	11	20.37
Aquariums	37	15	28.84
Germinating Beds	22	27	55.10

*

Reports based on 56 exempted village schools.

TABLE XC

NUMBER OF LABORATORIES AND SCIENCE ROOMS IN OHIO'S CITY SCHOOLS
EQUIPPED WITH CERTAIN TYPES OF FURNISHINGS, EQUIPMENT, AND
APPARATUS, AND NUMBER NOT SO EQUIPPED*

Equipment	Number Equipped	Number Not Equipped	Percentage Not Equipped
Teacher's Demonstration Desk	132	3	2.22
Water	133	2	1.48
Gas	135	1	0.73
Electricity	135	1	0.73
Shades	125	10	7.40
Opaque Projector	88	30	25.42
Motion Picture Equipment	131	4	2.96
Micro-projector	87	23	20.91
Models	90	14	13.46
Charts	119	4	3.25
Specimens	94	11	10.48
Aquariums	98	12	10.91
Germinating Beds	70	34	32.70

*

Reports based on 136 city schools

Interpretation of Tables LXXXVIII - XC

These three tables tell much the same story that was suggested by the three preceding tables. The story is one of poverty of equipment, apparatus, and supplies on the part of too many of the schools of the State of Ohio. This listing has been adopted by the Ohio State supervisors of Secondary Education, because of a belief that it is a fairly representative list of desirable equipment and apparatus. The general idea back of the selection of this group of items is that if the school has few or none of these items it is very likely to have little of any other science equipment or apparatus. Thus this somewhat abbreviated list is used by the state supervisors as an indicative listing.

Examination of the three tables listed will show that in general the county schools are in very poor condition so far as their possession of items on this list is concerned. On five of the thirteen items, less than half of the county schools of the state were equipped, and in some cases the percentage of those equipped was only from one in four to one in five.

Exempted village schools were in better case, but even here, less than half of the schools had germinating beds for use in biology and only half had any type of opaque projector, useful as it is in the teaching of science. On the other hand, every exempted village school in the state had electricity, gas, and water avail-

able for use in science classes. Comparison with similar figures for the county schools shows that on these items there were, respectively, 16 schools, 101 schools, and 39 schools which were without these most important services.

As might have been expected, the city schools led the way in equipment, with no item being missing from more than one school in three. Most of the city schools had most of the items listed, so, presumably the city schools were better equipped all the way around.

Even in the cities, however, conditions as revealed by the reports of the state supervisors were far from ideal. Three of the city schools did not have a teachers' demonstration desk, two of them lacked running water in the science room, one was without gas and one without electrical service.

Here also, a little more than one school in five had no micro-projector, even though this device has great utility in the larger classes found in the city schools. One of four had no type of opaque projector, and approximately one in three did not have germination beds for use in the biological sciences. These lacks might not be so important in themselves, but if the contentions of the state department of education are correct, they do indicate that other equipment is lacking in somewhat the same ratio.

Summary

Altogether, the situation in Ohio with regard to science rooms, their equipment, apparatus, and supplies ranges from very

good to very poor, on the basis of the reports submitted by the state supervisors of schools. As might be expected, conditions appeared to be almost uniformly poor in the very small schools, in many of which there was not even any room which might be called a science room.

Conditions improved in general with the pupil population of the schools, but even in the largest schools not all conditions were recorded as being good. Even in Ohio's city schools, four were found wherein the conditions registered were "poor," while almost ten per cent of the city schools could register no better than "fair." There is no evidence that the reports of the state supervisors were biased or unfair in any way, and as has been pointed out earlier, this small group of men, often working together on a school situation, is in better position than is any similar group or any individual to view total conditions in the schools of the state.

This chapter may be summarized briefly as follows:

1. In general, conditions in Ohio's public secondary schools with regard to adequacy of science rooms, equipment, and supplies ranges from very poor (and non-existent) to very good and even excellent.
2. Few schools were rated as excellent.
3. An appreciable number of schools were listed as having no science room of any type. These were all county schools.
4. In general the poorest conditions reported were in the county schools having enrollments of from one to twenty-five pupils per grade.

5. In general, conditions improved with increase in pupil population per grade, although this was not true in all cases.
6. Data were somewhat incomplete, due to the fact that not all items in some of the supervisors' reports had been completed. Rather complete information was available, however, on an appreciable sampling of the state's public secondary schools in each of the pupil population brackets.

CHAPTER VII

AREAS OF TEACHING AND TEACHING LOAD OF THE SCIENCE TEACHERS IN OHIO'S PUBLIC SECONDARY SCHOOLS

INTRODUCTION

Factor 10 in the list of seventeen factors listed in a previous chapter has to do with the load of the teacher. In order to determine teacher load, a great number of factors must be considered. Among them should be included the number and type of preparations, number of classes taught per day and relatedness of the work of the various classes. Part of the information concerning teacher load is, perhaps, too ephemeral to be measured by present-day devices, however, it is susceptible to some interpretation. In the present investigation, certain facts about teacher load in general have been developed from the reports of the high school principals, others have come out of questionnaires to the science teachers of the state. No attempt has been made to measure individual teacher load, nor to direct attention toward certain individuals who may be carrying an excessive load, nor to certain schools where the load may be thought of as excessive. Rather, this chapter and a part of a subsequent one have directed attention to the general picture of teacher load in Ohio. Data concerning the areas of teaching, number of preparations, per day, number of study halls per day, and amount and type of extra-curricular responsibility have been presented.

The Teaching Principal

A common complaint of principals in smaller schools is that their teaching suffers greatly from the fact that they have the administrative responsibility for the school. This study reveals the extent to which the principal was also the science teacher in the schools of Ohio. Reference to Table XCI shows that in the small school, it was very common practice indeed for the principal also to be the science teacher. This practice certainly has implications with regard both to the principalship and to the teaching of the sciences. As the schools increased in size, the frequency of the principal-science-teacher combination decreased in incidence, although as may be seen it still existed in some of the (comparatively) larger schools.

In all data relative to areas of teaching, and to the preparation of teachers in the schools, an attempt has been made to divide the schools in some measure with regard to pupil population. Because of the fact that there are three-year, four-year, five-year, and six-year schools concerned, an attempt to divide them into groups on a basis of total enrollment is not quite fair. The plan decided upon was to classify the schools according to enrollment per grade. Thus the county schools were classified as follows:

- 1 - 25 per grade
- 26 - 50 per grade
- 51 and over per grade.

The exempted villages were not divided since they form a very small group, but the cities were divided into categories as follows:

- 1 - 100 per grade
- 101 - 200 per grade
- 201 - 300 per grade
- 301 and over per grade.

The population of each school was taken from the listing in the 1950-51 Directory of Ohio High Schools.¹

The number of teaching principals is indicated in the following table.

1

Ohio State Department of Education, Educational Directory
School Year 1950-51. Columbus: The Department. 1951. Pp. 1 + 145.

TABLE XCI

NUMBER AND PER CENT OF PRINCIPALS OR EXECUTIVE HEADS OF OHIO'S
PUBLIC SECONDARY SCHOOLS WHO WERE TEACHING ONE OR MORE CLASSES
OF SCIENCE, 1950 - 51

Type and Size of School	Number of Schools in this Category	Number of Teaching Executives	Per cent Teaching
County Schools, 1 - 25 per grade	372	115	30.91
County Schools, 26 - 50 per grade	329	72	21.90
County Schools, 51 and over per grade	114	17	14.91
Exempted Village Schools	84	19	22.62
City Schools, 1 - 100 per grade	23	0	0
City Schools, 101 - 200 per grade	56	0	0
City Schools, 201 - 300 per grade	35	0	0
City Schools, 301 and over per grade	49	0	0
Totals	1062	223	21.00

The principal or executive head of the high school taught at least one class of science per day in almost one-third of the smallest county high schools, the figure dwindled to a little more than one-fifth in the next group in size, then dropped again to approximately one of seven in the largest county schools. In the exempted village schools, on the other hand, the figure rose to considerably more than one-fifth, or a fraction greater than for the medium-sized county high schools.

In interpreting the figure for the exempted village schools as compared with the county schools in the "51 and over" classification, one important factor must be kept in mind. In these larger county schools, usually one man is charged with the duties of operating the high school, and is in effect high school principal. In this situation the executive head assumes duties which are more nearly like those of a superintendent.

Thus when the exempted villages show a higher per cent of their executive heads teaching science than was true for the county schools in the classification directly below them, a fair comparison is scarcely being made. Unfortunately, the data did not admit of a fairer comparison. The principals' reports of the county schools did not list officials of the high school other than the executive head, nor did they indicate which high schools have principals designated and which do not. While the data are not fair to the exempted villages, there were no other data.

Schools with one Science Teacher

In quite a number of instances (in the smaller schools particularly) all of the science which was taught in the school was in the care of only one person. This number also reduced rather quickly in proportion as the schools achieved larger numbers of pupils per grade, and was not particularly significant in the city schools. Table XCII presents these data for the county schools.

TABLE XCII

NUMBER AND PER CENT OF COUNTY SCHOOLS HAVING ONLY ONE INDIVIDUAL
TEACHING SECONDARY-SCHOOL SCIENCE

Population of School	Total Number of Schools	Number Having Only One Science Teacher	Per Cent
1 - 25 per grade	372	174	46.77
26 - 50 per grade	329	103	31.31
51 and over per grade	114	14	12.28
Totals	815	291	35.71

Whereas almost half of the smallest county schools had only one person entrusted with all science teaching, the figure dropped to less than one-third for the medium-sized, and to about one-tenth for the largest county schools.

Teaching Combinations in the County Schools

Most school people have become accustomed to thinking in terms of one subject or of one area of teaching as a "major" area. It is difficult to define a major area of teaching, however, in the case of many of the teachers of the county schools, particularly in the smaller units. There are many teachers who were teaching one class each of a number of different subjects, and in many instances it not only was not possible to determine a major subject, it likewise was impossible to detect a major subject area. The difficulty lessened as the schools became larger, but data relative to training indicate that the lesser trained personnel were more likely to be found in the smaller schools where the likelihood of being required to teach a considerable number of different subjects was greater. The following tables indicate the conditions as they existed in the county high schools with respect to teaching combinations. The first series of tables concerns the schools, 372 in number, which had enrollments of from 1 to 25 pupils per grade.

TABLE XCIII

NUMBER OF SCIENCE TEACHERS IN OHIO'S COUNTY HIGH SCHOOLS
(ENROLLMENTS 1 - 25 PUPILS PER GRADE) WHO TAUGHT CERTAIN
SCIENCE COMBINATIONS AND CERTAIN OTHER SUBJECTS OR AREAS

Subject Combination	Number of Teachers
General Science and Biology	43
General Science and Chemistry	18
General Science and Physics	38
General Science, Chemistry and Physics	1
General Science, Biology, and Chemistry	13
General Science, Biology, and Physics	44
General Science, Chemistry, Biology, and Physics	0
Biology and Chemistry	8
Biology and Physics	8
Biology, Chemistry and Physics	0
Chemistry and Physics	0
Total Number of Teachers	173
Number of Teachers Teaching Only the Combination Listed in this Tabulation	14
Number of Teachers Teaching the Combination Listed Above plus Two or More Subjects or Areas other Than Science	113

TABLE XCIV

ADDITIONAL SUBJECTS OR AREAS TAUGHT BY THE 173 TEACHERS IN THE
SMALLEST OHIO COUNTY HIGH SCHOOLS WHO ARE LISTED IN TABLE XCIII

Additional Subjects Taught	Number of Teachers
Seventh and Eighth Grade Science	91
Pre-Flight Aeronautics	1
Senior Science	5
Physiology	1
Conservation	2
Mathematics	61
Social Studies	42
English	20
Foreign Language	8
Industrial Arts	18
Commercial Subjects	7
Home Economics	4
Agriculture	7
Physical Education	42
No Other Subject	14

The particular group of 173 teachers referred to in Tables XCIII and XCIV are of particular interest due to the fact that they are, for the most part, teachers who definitely were teaching a major portion of their time in the science field. They were, in effect, science teachers who were teaching from two to three (or four if seventh and eighth grade science is counted) science subjects. In addition they have been called upon to teach one, two, or three subjects from a great variety of offerings. While these run the gamut of high school subjects, apparently the teacher with a broad background of science, and preparation in social studies, mathematics, physical education, industrial arts, or English, would be a valuable person in one of these smaller high schools.

In addition to the 173 teachers in the county schools who were teaching certain science combinations as listed in the preceding tables, there were quite a number who actually may be said to have been devoting a majority of their teaching time to one science subject. While many of these individuals were principals who taught perhaps only a few classes, yet in the sense of this study, this caused them to be considered as doing the major share of their teaching in the given field. Additionally, there were many teachers who were found to be devoting the major portion of their time to other subjects or other areas of the curriculum, but who were teaching one or a few classes in the science areas. All of these

situations have been described statistically in the following tables as they concerned conditions in the small Ohio high schools. These data represent comparable figures to those in Tables XCIII and XCIV insofar as size of high school is concerned.

TABLE XCV

TEACHERS IN OHIO'S SMALLEST COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Seven and Eight Science	8
Mathematics	3
Social Studies	5
English	2
Foreign Language	1
Industrial Arts	4
Commercial Subjects	1
Home Economics	1
Physical Education and Health	1
No Minor Subjects	9
Two or More Minor Subjects	10
Total Number in This Category	23

All nine of those having no minor areas, teaching physics only, were either executive heads of schools or part-time teachers.

The proportion of teachers in the smaller schools having a rather heavy load from the standpoint of number of preparations is indicated by the fact that of the 23 teachers in this category, there were ten who were teaching two or more subjects or in two or more areas other than in physics.

TABLE XCVI

TEACHERS IN OHIO'S SMALLEST COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Seventh and Eighth Science	2
Mathematics	5
Social Studies	3
English	6
Industrial Arts	1
Physical Education	2
Instrumental Music	1
No Minor Areas	2
Two or More Minor Areas	7
Total Number in this Category	13

To an even greater extent, percentagewise, than in physics, the teachers whose major area of teaching was in chemistry were forced to go into two or more minor areas. Seven of the thirteen teachers in the group represented in Table XCVI were teaching in

two or more areas in addition to chemistry. The two who were teaching chemistry alone were executive heads of schools.

TABLE XCVII

TEACHERS IN OHIO'S SMALLEST COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
General Science	1
Seventh and Eighth Grade Science	5
Senior Science	3
Mathematics	14
Social Studies	11
English	6
Foreign Language	1
Industrial Arts	3
Home Economics	2
Commercial Subjects	4
Agriculture	5
Physical Education	9
Music	2
Art	1
No Minor Subjects	1
Two or More Minor Areas	19
Total Number of Teachers in this Category	28

The general conditions discovered in earlier tables concerning teachers of chemistry and physics were repeated in the study of

the biology teachers in the small schools. Of the 28 teachers represented, 19 were teaching in two or more areas other than biology. Only one was teaching biology alone.

TABLE XCVIII

TEACHERS IN OHIO'S SMALLEST COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Biology	2
Seventh and Eighth Grade Science	15
Senior Science	5
Conservation	1
Mathematics	13
Social Studies	11
English	7
Foreign Language	1
Industrial Arts	8
Home Economics	3
Commercial Subjects	2
Agriculture	2
Physical Education	14
Two or More Minor Areas	29
Total Number of Teachers	32

Teachers of general science in the smallest county schools were more likely than any other group of the "science major" teachers to be teaching in two or more areas other than that of their major area of teaching. Of 32 teachers in this category, all but three were teaching in at least two other areas of endeavor.

Reference to the three preceding tables will show that teachers whose major area of teaching is in one of the sciences (in the smallest category of county schools) may be expected to teach almost any other subject or area in the curriculum. No subject is absent from the listing even the music and art have been included. By and large, however, one of the areas included is quite likely to be mathematics. Social studies and physical education also were well represented as minor areas.

TABLE XCIX

NUMBER OF TEACHERS IN OHIO'S SMALLEST COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS MATHEMATICS AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	77
Biology	16
Chemistry	16
General Science	60
Senior Science	3
Conservation	1
Seventh and Eighth Grade Science	25
Other (Non-Science) Minor Areas	48
Number Teaching Two or More Science Areas	58
Total Number of Teachers in this Category	126

Table XCIX indicates that to a considerable extent in the smallest county schools, the person teaching physics is likely to be the mathematics teacher. This condition may not be too serious providing the mathematics teacher has a background of physics, but there are no data to indicate that such a situation prevails. Usually in such schools, there is only one section of physics, and, as indicated in the preceding table, in 77 of the

372 county schools in this category, the physics has been appended to the mathematics teachers' day. General science, also, was more likely to be taught by a teacher whose major area of teaching was in mathematics than by a teacher who taught general science during a major portion of the day.

Mathematics teachers were much more likely to be teaching physics or general science than they were to be teaching biology or chemistry.

TABLE C

NUMBER OF TEACHERS IN THE SMALLEST DIVISION OF COUNTY SCHOOLS OF OHIO WHOSE MAJOR TEACHING AREA WAS SOCIAL STUDIES AND WHO HAVE HAD CERTAIN MINOR AREAS OF TEACHING WHICH INCLUDED SECONDARY SCIENCE SUBJECTS

Minor Areas of Teaching	Number of Teachers
Physics	6
Chemistry	3
Biology	29
General Science	39
Seventh and Eighth Grade Science	17
Botany	1
Senior Science	1
Physiology	1
Conservation	1
Other (non-science) Minor Areas	59
Number Teaching in Two or More Science Areas in Addition to Major Area	21
Total Number of Teachers in this Category	75

Teachers in the smallest county schools whose major area of teaching was in the social sciences were very likely to be teaching either general science or biology. Of the 75 teachers in this category, over half were teaching general science, and somewhat less than half were teaching biology.

TABLE CI

NUMBER OF TEACHERS IN THE SMALLEST OHIO HIGH SCHOOLS WHOSE MAJOR TEACHING AREA WAS HOME ECONOMICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING WHICH INCLUDED SECONDARY SCIENCE SUBJECTS

Minor Areas of Teaching	Number of Teachers
Physics	0
Chemistry	3
Biology	20
General Science	7
Seventh and Eighth Grade Science	6
Other (non-science) Minor Areas	27
Number Teaching in Two or More Science Areas	8
Total Number of Teachers in this Category	27

Teachers in this category of schools whose major areas of activity was in home economics and who also taught some science were very likely to be biology teachers, and considerably less likely to be teachers of any other type of science. Of the 27, all but seven taught biology.

TABLE CII

NUMBER OF TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO WHOSE MAJOR AREA OF TEACHING WAS AGRICULTURE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING WHICH INCLUDE SECONDARY SCIENCE SUBJECTS

Minor Areas of Teaching	Number of Teachers
Biology	1
Other (non-science) Minor Areas	1
Total Number of Teachers in this Category	1

With only one teacher represented in Table CII, no interpretation is justified.

TABLE CIII

NUMBER OF TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO WHOSE MAJOR AREA OF TEACHING WAS ENGLISH AND WHO HAD CERTAIN MINOR AREAS OF TEACHING WHICH INCLUDED SECONDARY SCIENCE SUBJECTS

Minor Areas of Teaching	Number of Teachers
Physics	4
Chemistry	3
Biology	10
General Science	5
Seventh and Eighth Grade Science	2
Other (non-science) Minor Areas	14
Number Teaching in Two or More Science Areas	4
Total Number of Teachers in this Category	20

Half of the teachers whose major area of teaching was in English (and who also taught some science) were also teaching biology. Only one-fourth of them were teaching general science, and lesser numbers were teaching other science subjects. Considering the number of teachers in this category of the county schools who may be presumed to have been teaching English a major portion of their time, the number of such teachers who also had science areas was very small. While the generalization is not quite accurate, it may be said that by and large, English teachers in the smallest category of the county schools do not teach science to any extent.

TABLE CIV

NUMBER OF TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO WHOSE MAJOR AREA OF TEACHING WAS HEALTH OR PHYSICAL EDUCATION AND WHO HAD CERTAIN MINOR AREAS OF TEACHING WHICH INCLUDED SECONDARY SCIENCE SUBJECTS

Minor Area of Teaching	Number of Teachers
Physics	2
Chemistry	1
Biology	9
General Science	11
Seventh and Eighth Grade Science	9
Senior Science	1
Other (non-science) Minor Areas	18
Number Teaching in Two or More Science Areas	11
Total Number of Teachers in This Category	21

Of the 21 teachers in the category listed in Table CIV, slightly over half were listed as teaching general science, almost as many were teaching biology. Only a very few (two in one case, one in the other) were teaching chemistry or physics. They were quite likely also to be teaching seventh and eighth grade science.

TABLE CV

NUMBER OF TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO WHOSE MAJOR AREA OF TEACHING WAS COMMERCIAL AND WHO HAD CERTAIN MINOR AREAS OF TEACHING WHICH INCLUDED SECONDARY SCIENCE SUBJECTS

Minor Areas of Teaching	Number of Teachers
Physics	3
Chemistry	2
Biology	7
General Science	5
Senior Science	1
Other (non-science) Areas	9
Number Teaching in Two or More Science Areas	13
Total Number of Teachers in this Category	15

Commercial teachers were less likely to be teaching science in the smallest category of county schools than were most other groups of teachers. When they did teach science, they were more likely to teach biology or general science, less likely to teach chemistry or physics.

TABLE CVI

NUMBER OF TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO WHOSE MAJOR AREA OF TEACHING WAS INDUSTRIAL ARTS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING WHICH INCLUDED SECONDARY SCIENCE SUBJECTS

Minor Areas of Teaching	Number of Teachers
Physics	8
Chemistry	1
Biology	12
General Science	13
Seventh and Eighth Grade Science	11
Senior Science	1
Other (non-science) Areas	20
Number Teaching in Two or More Science Areas	12
Number (Total) of Teachers in this Category	31

Teachers in the smallest category of schools whose major area of teaching was in industrial arts and who also taught some science were quite likely to be teaching general science or biology. They also were rather likely to be teaching physics (8 of 31).

TABLE CVII

NUMBER OF TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO WHOSE MAJOR AREA OF TEACHING WAS ART AND WHO HAD CERTAIN MINOR AREAS OF TEACHING INCLUDING SECONDARY SCIENCE SUBJECTS

Minor Areas of Teaching	Number of Teachers
Biology	1
Other (non-science) Areas	1
Total Number of Teachers in this Category	1

The number of teachers whose major area of teaching was art, and who had minor areas of teaching in science was so small as to be of no particular significance.

TABLE XVIII

DISTRIBUTION OF SCIENCE TEACHERS IN THE SMALLEST COUNTY SCHOOLS OF OHIO, WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR PORTION OF THEIR TEACHING TIME

Major Area of Teaching	Number of Teachers	Per cent of total group
Science Combination	173	29.51
Physics	23	3.92
Chemistry	13	2.22
Biology	28	4.78
General Science	32	5.37
Mathematics	126	21.50
Social Studies	75	12.50
Home Economics	27	4.61
Agriculture	1	0.17
English	20	3.41
Health or Physical Education	21	3.58
Commercial	15	2.56
Industrial Arts	31	5.20
Art	1	0.17
Total Science Majors	269	45.80
Total Non-Science Majors	317	54.00
Total Number of Teachers	586	100.00

Table CVIII does not indicate that more pupils were being taught science by teachers whose major area of teaching was not in science, but it does indicate this condition as a possibility. The table shows that more non-science majors (so far as teaching time is concerned) were teaching science than were science majors. While this condition probably is inherent in the organization of the very small school, it is not likely to result in singleness of purpose on the part of the teachers of a great body of students in the smaller schools. The fact that the teacher was teaching a class or two of science, appended to a schedule of mathematics, physical education, or other area of work is not particularly conducive to strong interest in the minor area of teaching.

The very heavy load from the standpoint of number of preparations per day is indicated by a close perusal of the preceding tables, but is shown more clearly in Table CIX.

TABLE CIX

NUMBER OF SEPARATE PREPARATIONS PER DAY OF 587* SCIENCE TEACHERS
IN THE SMALLEST CATEGORY OF COUNTY SCHOOLS OF OHIO

Number of Preparations per Day	Number of Teachers	Percentages
1	11	1.87
2	33	5.62
3	59	10.05
4	130	22.15
5	212	36.12
6	121	20.61
7	18	3.07
8	3	0.51
Totals	587	100.00

*

Compares with 586 in preceding table. Data concerning teachers duties of one teacher were not complete and this teacher was omitted from the preceding tables.

Approximately one-fourth of all of the science teachers in the schools represented by the classification used were required to make preparation in six, seven, or eight different subjects per day. Approximately sixty per cent of all such teachers were required

to prepare in at least five subjects per day.

The picture becomes even a little more gloomy when it is remembered that most of those listed as having preparation in only one or two subjects actually were executive heads or principals of these schools who actually had in many cases more than the equivalent of several preparations in added administrative and supervisory duties. Little need be said concerning the difficulty of carrying out a schedule involving preparation in five, six, seven, or eight discrete subjects, together with the teaching and the extra-curricular responsibility which accompanies the teacher in the small school.

Coincident with the number of preparations is the total number of teaching periods of the 587 teachers here represented. Excessive teaching load may be found also in an excessive number of classes. Table CX indicates the number of classes taught by the Ohio Science teachers in the category under discussion.

TABLE CX

NUMBER OF CLASSES TAUGHT BY SECONDARY TEACHERS OF SCIENCE IN
THE SMALLEST HIGH SCHOOLS OF OHIO'S COUNTIES

Number of Classes Taught per Day	Number of Teachers	Percentages
1	11	1.87
2	31	5.28
3	55	9.37
4	95	16.19
5	201	34.24
6	150	25.55
7	34	5.79
8	10	1.70
Total	587	100.00

The data indicate that approximately one-third of all county teachers in the category under discussion taught six or more classes per day, while over two-thirds taught five or more classes per day. Recalling that many of those teaching one, two, three, or even four classes per day were principals or executive heads of schools, the curve is skewed still further. Another point

to recall in making comparisons with teachers in other subject-matter areas is that in many cases the classes being taught were double-period rather than single-period classes.

Reference to Tables XCV, XCVI, XCVII, and XCVIII shows that in the secondary schools of the category being discussed, there were but 12 teachers who taught only one science. Further reference to Table CX indicates that eleven of these twelve taught only one period per day. In all cases, they were either principals or part-time teachers.

The Medium-Sized County High School

High schools in this category are those with pupil enrollments of from 26 to 50 pupils per grade. There were 329 high schools in this category among the public secondary schools of the state under county organization. Previous tables (Tables XCI and XCII) have indicated that in general there existed a somewhat more favorable situation in schools of this size than in the extremely small high school with respect to certain factors. Other comparisons have been drawn in later portions of this chapter.

Table XCI is comparable with Table XCIII, except that it concerns teachers in the medium-sized high schools rather than those in the smaller category. The tables following it are comparable to Tables XCV, with exactly the same difference as in the case of Table XCIII. These tables are given as follows:

TABLE CXI

NUMBER OF SCIENCE TEACHERS IN THE MEDIUM-SIZED COUNTY SCHOOLS OF OHIO WHO TAUGHT CERTAIN SCIENCE COMBINATIONS AND CERTAIN OTHER SUBJECTS OR AREAS

Subject Combination	Number of Teachers
General Science and Biology	53
General Science and Chemistry	16
General Science and Physics	33
General Science, Chemistry, and Physics	14
General Science, Biology, and Physics	48
General Science, Biology, and Chemistry	16
General Science, Biology, Chemistry, and Physics	6
Biology and Chemistry	6
Biology and Physics	10
Biology, Chemistry, and Physics	5
Chemistry and Physics	4
Total Number of Teachers	211
Number of Teachers Teaching only the Combination listed in this Tabulation	26
Number of Teachers Teaching the Combination listed Plus Two or More Subjects or Areas Other Than Science	90

TABLE CXII

ADDITIONAL SUBJECTS OR AREAS TAUGHT BY THE 211 TEACHERS
LISTED IN TABLE CXI

Additional Subjects Taught	Number of Teachers
Seventh and Eighth Grade Science	102
Senior Science	6
Coal Mining Science	3
Mechanics	1
Mathematics	70
Social Studies	30
English	6
Foreign Languages	2
Industrial Arts	13
Commercial	3
Home Economics	0
Agriculture	7
Physical Education and Health	39
Driving	4
Music	2
No Other Subject	26

Reference to the two preceding tables, Table CXI and CXII, indicates that not only were the teachers in the medium-sized category of county schools teaching a less diversified schedule than were those in the preceding group (see Tables XCIII and XCIV) but they also were more likely to be teaching subjects related to their secondary-school science area. For example, of 211 teachers, 102 were teaching seventh or eighth grade science as an area in addition to their major area of secondary-school science.

A much smaller per cent of these teachers were teaching two or more areas other than secondary-school science than was true in the case of the teachers in the preceding category.

TABLE CXIII

NUMBER OF TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS
WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD CERTAIN
OTHER MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Seventh and Eighth Grade Science	5
Senior Science	1
Mathematics	5
Social Studies	2
English	1
Foreign Language	1
Industrial Arts	2
Commercial	1
Physical Education and Health	3
No Minor Subjects	7
Two or More Minor Areas	6
Total Number of Teachers in this Category	19

The teachers in Ohio's medium-sized category of county high schools who taught physics a major portion of their time were very likely to be teaching in other scientific areas or in mathematics. They were much less likely to be teaching in any other areas of endeavor, and of the 19 in this category, seven had no minor areas of teaching. Most of these individuals were executive heads of schools.

TABLE CXIV

NUMBER OF TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS
WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD CERTAIN
OTHER MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	1
Seventh and Eighth Grade Science	2
Mathematics	1
Social Studies	1
No Minor Subjects	9
Two or More Minor Areas	1
Total Number of Teachers in this Category	13

While the group of teachers represented in Table CXIV is rather small, it does represent a group which is almost entirely devoted to the teaching of science. Of the 13 individuals, nine

had no teaching responsibility other than chemistry, and only one was teaching any subject other than within the science area.

TABLE CXV

TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
General Science	1
Seventh and Eighth Grade Science	5
Senior Science	1
Mathematics	8
Social Studies	5
English	4
Foreign Language	2
Industrial Arts	1
Commercial Subjects	1
Agriculture	1
Physical Education	12
Art	2
Driver Education	1
No Minor Subjects	1
Two or More Minor Areas	13
Total Number of Teachers in this Category	26

Perhaps the most noteworthy item in Table CXV is that of those teachers who were teaching biology a major portion of their time in this category of schools, so many were teaching in the area of physical education. No teacher in this category was teaching chemistry or physics and only one was teaching general science. The high incidence of physical education teachers listed in this table and in the succeeding table gives some indication concerning the number of coaches who were teaching science in the county schools at the time of this study.

TABLE CXVI

TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN OTHER MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	7
Biology	4
Chemistry	5
Seventh and Eighth Grade Science	18
Physiology	1
Mathematics	11
Social Studies	17
English	5
Industrial Arts	3
Agriculture	1
Physical Education	16
Driver Education	4
Music	1
No Minor Subjects	0
Two or More Minor Areas	32
Total Number of Teachers in this Category	46

In the category of teachers represented in Table CXVI, it may be seen that even here, general science teachers are still "generalized" when it comes to teaching areas. Most areas of the curriculum have been included, and in most cases the representation is generous. In this category, the general science teacher is very likely to be called upon also to be the social science teacher or the physical education teacher.

TABLE CXVII

TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS MATHEMATICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	53
Chemistry	19
Biology	22
General Science	38
Seventh and Eighth Grade Science	5
Senior Science	3
Aeronautics	1
Other (non-science) Minor Areas	32
Number teaching in Two or More Science Subjects	30
Total Number of Teachers in this Category	107

In the category of teachers represented in Table CXVII, the number of teachers whose major area of teaching is mathematics and who also have areas in one or the other of the four major sciences is rather remarkable. In the medium-sized high school,

the mathematics teacher is certainly very likely to be called upon to teach at least one area of science, and in many cases more than one area.

TABLE CXVIII

TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS SOCIAL STUDIES AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SECONDARY SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	6
Chemistry	1
Biology	33
General Science	22
Seventh and Eighth Grade Science	10
Senior Science	1
Physiology	1
Other (non-science) Minor Areas	31
Number Teaching in Two or More Science Areas	16
Total Number of Teachers in this Category	56

As with the smallest category of county high schools, the social studies teacher is very likely to be called upon to teach biology particularly, but may be required to teach general science. He is much less likely to be asked to teach any of the other sciences.

TABLE CXIX

TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS HOME ECONOMICS AND WHO HAD CERTAIN MINOR AREAS IN SECONDARY SCIENCE

Minor Areas of Teaching	Number of Teachers
Chemistry	4
Biology	15
General Science	14
Seventh and Eighth Grade Science	3
Other (non-science) Minor Areas	16
Number Teaching in Two or More Science Areas	5
Total Number of Teachers in this Category	31

The home economics teacher may be called upon to teach science in the medium-sized high school, but in this study it was found that she was very unlikely to be called upon to teach either chemistry or physics. Biology and general science were found several times as frequently as any of the others in the home economics teacher's schedules.

TABLE CXX

TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR
AREAS OF TEACHING WAS AGRICULTURE AND WHO HAD CERTAIN MINOR
AREAS OF TEACHING IN SECONDARY
SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	1
Biology	1
General Science	1
Other (non-science) Minor Areas	3
Total Number of Teachers in this Category	3

There were so few teachers listed in the category represented by Table CXX as to be of no particular significance statistically.

TABLE CXXI

TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR
AREA OF TEACHING WAS ENGLISH AND WHO HAD CERTAIN MINOR AREAS
OF TEACHING IN SECONDARY SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	4
Biology	13
General Science	4
Seventh and Eighth Grade Science	4
Physiology	1
Other (non-science) Minor Areas	9
Number Teaching in Two or More Science Areas	8
Total Number of Teachers in this Category	17

As in the smallest group of schools, the English teacher was very unlikely to be the science teacher, and in most cases if he was, the subject taught was biology.

TABLE CXXII

TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREAS OF TEACHING WAS FOREIGN LANGUAGE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SECONDARY SCIENCE

Minor Areas of Teaching	Number of Teachers
Chemistry	2
Biology	2
General Science	2
Other (non-science) Minor Areas	1
Number Teaching in Two or More Science Areas	1
Total Number of Teachers in this Category	4

Statistically of little significance were the data recorded in Table CXXII. The only significance to be attached to the figures is that for all practical purposes, foreign language teachers have not been called upon to teach the sciences in this category of high schools.

FACTORS OF EFFECTIVENESS IN SCIENCE TEACHING AND THEIR APPLICATION
TO THE TEACHING OF SCIENCE IN OHIO'S PUBLIC SECONDARY
SCHOOLS

DISSERTATION

Presented in Partial Fulfillment of the Requirements
for the Degree Doctor of Philosophy in the
Graduate School of The Ohio State
University

Volume II

By

WARREN MAYWOOD DAVIS, B. A., A. M.

The Ohio State University

1952

OHIO STATE
UNIVERSITY

TABLE CXXIII

TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS HEALTH OR PHYSICAL EDUCATION AND WHO HAD MINOR AREAS OF TEACHING IN SECONDARY SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	3
Chemistry	1
Biology	25
General Science	12
Seventh and Eighth Grade Science	11
Senior Science	1
Physiology	1
Other (non-science) Minor Areas	23
Number Teaching in Two or More Science Areas	15
Total Number of Teachers in this Category	37

Bearing out the general impression that science teaching is likely to be done by the coach in this category of school, Table CXXIII indicates that quite a number of teachers whose major area of teaching is physical education also teach science, particularly biology, and to a somewhat lesser extent, general science.

TABLE CXXIV

TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS INDUSTRIAL ARTS AND WHO HAD MINOR AREAS OF TEACHING IN SECONDARY SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	4
Chemis try	3
Biology	6
General Science	9
Seventh and Eighth Grade Science	2
Senior Science	1
Other (non-science) Teaching Areas	8
Number Teaching in Two or More Science Areas	5
Total Number of Teachers in this Category	19

Teachers of industrial arts in this category of school seemed less likely to be teaching science than in the smaller schools. The science subjects taught by this group of teachers were scattered with more teaching general science than any other.

TABLE CXXV

TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS COMMERCIAL AND WHO HAD MINOR AREAS OF TEACHING IN SECONDARY SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	4
Other (non-science) Teaching Areas	2
Total number of Teachers in this Category	4

As with the teachers in agriculture, there were so few cases listed in Tables CXXV and CXXVI as to be statistically not significant. Again, the only significance rests in the fact that in this type of high school, commercial teachers and music and art teachers are very unlikely to be called upon to teach science.

TABLE CXXVI

TEACHERS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS MUSIC AND WHO HAD MINOR AREAS OF TEACHING IN SECONDARY SCIENCE

Minor Areas of Teaching	Number of Teachers
Chemistry	1
Biology	1
General Science	2
Other (non-science) Teaching Areas	2
Number Teaching in Two or More Science Areas	1
Total Number of Teachers in this Category	3

Similar conditions prevailed in the medium-sized high schools to those previously determined for the small-sized high schools of the county systems. Physics appears to have been taught much more often by mathematics teachers in the schools in both of these classes than by physics teachers.

The distribution of science teachers with regard to the area of their teaching which requires the major portion of their school day is indicated in Table CXXVII as follows:

TABLE CXXVII

DISTRIBUTION OF SCIENCE TEACHERS IN THE MEDIUM-SIZED COUNTY SCHOOLS OF OHIO, WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR PORTION OF THEIR TEACHING TIME

Major Area of Teaching	Number of Teachers	Per cent of Total Group
Science Combination	211	35.46
Physics	19	3.16
Chemistry	13	2.18
Biology	26	4.37
General Science	46	7.73
Mathematics	106	17.82
Social Studies	56	9.41
Home Economics	31	5.21
Agriculture	2	0.52
English	17	2.86
Foreign Language	4	0.69
Health or Physical Education	37	6.22
Industrial Arts	19	3.16
Commercial	4	0.69
Music	3	0.52
Total Science Majors	315	52.90
Total Non-Science Majors	280	47.10
Total Number of Teachers	595	100.00

In this category of schools, it may be seen that unlike the smaller schools, a somewhat greater number of science teachers actually were teaching science for a major portion of the school day than otherwise. A greater number also, proportionately, were teaching a combination of sciences rather than one science combined with certain non-science subjects. The proportion of mathematics teachers who were teaching science also dropped by some four per cent, although it still was quite high. Other percentage variations seem not so significant, although they exist.

Teacher preparation load and teacher class load (number of classes per day) are indicated in the following tables, Table CXXVIII and CXXIX. They are to be interpreted similarly to Tables CIX and CX.

TABLE CXXVIII

NUMBER OF SEPARATE PREPARATIONS PER DAY BY 600* SCIENCE TEACHERS
IN THE MEDIUM-SIZED COUNTY SECONDARY SCHOOLS OF OHIO

Number of Preparations per Day	Number of Teachers	Per cent
1	17	2.83
2	43	7.17
3	83	13.83
4	171	28.50
5	200	33.33
6	73	12.50
7	9	1.50
8	2	0.33
Total	600	100.00

*

Compares with 595 teachers in preceding tables which represented those teachers with reasonably complete teaching records.

The situation with regard to number of preparations per day appeared to be more favorable to an effective science teaching situation in the medium-sized county schools than in the smallest schools. In these latter schools, approximately 24 per cent of the teachers had six or more preparations, whereas with the group of slightly larger schools, the percentage was just a little over

14 per cent. Some sixty per cent of the small-school teachers had five or more preparations per day, whereas with this group, the percentage was less than 48 per cent. Another factor which should be considered also is that proportionately fewer of these teachers were teaching principals, thus the situation was more favorable to the teachers in the medium-sized schools than is immediately apparent from an examination of Tables CIX and CXXVIII.

TABLE CXXIX

NUMBER OF DIFFERENT CLASSES TAUGHT PER DAY BY 600 SCIENCE TEACHERS IN THE MEDIUM-SIZED COUNTY SCHOOLS OF OHIO

Number of Classes Taught per Day	Number of Teachers	Per cent
1	17	2.83
2	33	5.50
3	42	7.00
4	104	17.33
5	225	37.50
6	142	23.67
7	29	4.83
8	8	1.33
Totals	600	100.00

As with the smallest schools, the median teacher in this group of schools taught five classes per day, however, there are a few less (percentagewise) in the group teaching six or more classes per day. The comparative percentages here are approximately 30 per cent and 33 per cent.

The percentage differences between the two groups is not significant, however, insofar as the number teaching **four** classes or less is concerned. Both groups here ranged between thirty-two and thirty-three per cent. In any comparison of figures at this end of the scale, however, one should keep in mind the disparity between the numbers of principals included in the two categories.

The number of teachers in the group teaching only one science is not significantly greater than is the case with the group treated earlier. Only 17 teachers in this group taught only one subject. These all are listed as being teachers who teach one period only per day. In short they are administrators and part-time teachers.

The Larger County High Schools

Schools in this category, 137 in number, embrace the county secondary schools having an enrollment of 51 or more per grade. This is the largest of the three categories into which county schools were divided. Tables have been presented herewith which are in all respects comparable with those tables used earlier in connection with the other two categories of county schools.

TABLE CXXX

NUMBER OF SCIENCE TEACHERS IN THE LARGER COUNTY HIGH SCHOOLS OF OHIO WHO TAUGHT CERTAIN SCIENCE COMBINATIONS ALONG WITH CERTAIN OTHER SUBJECTS OR AREAS

Subject Combination	Number of Teachers
General Science and Biology	11
General Science and Chemistry	7
General Science and Physics	3
General Science, Chemistry, and Physics	12
General Science, Biology, and Chemistry	4
General Science, Biology, and Physics	8
General Science, Biology, Chemistry and Physics	5
Biology and Chemistry	3
Biology and Physics	5
Biology, Chemistry and Physics	2
Chemistry and Physics	8
Total Number of Teachers in this Category	67
Number of Teachers Teaching Only the Combination listed in this Tabulation	19
Number Teaching the Combination listed Plus Two or More Subjects or Areas other than Science	13

In comparison with the two groups of teachers discussed earlier in this chapter, the most striking item in Table CXXX is the dwindling number of individuals who taught two or more subjects in addition to the science combinations listed.

TABLE CXXXI

ADDITIONAL SUBJECTS OR AREAS TAUGHT BY THE 67 TEACHERS LISTED
IN TABLE CXXX

Additional Subjects Taught	Number of Teachers
Seventh and Eighth Grade Science	16
Senior Science	5
Aeronautics	2
Mining Science	1
Photography	1
Mechanics	1
Mathematics	17
Social Studies	11
Foreign Language	1
Industrial Arts	1
Agriculture	1
Physical Education	4
Driver Training	2
No Other Subject	19
Total number of Teachers in this Category	67

In comparison with the conditions shown for the smallest schools in Table XCIV, Table CXXXI indicates a relatively short list of additional subjects taught by those teachers who were teaching the science combinations listed in Table CXXX. Aside from the sciences, mathematics, and social studies, little of statistical importance has been listed.

TABLE CXXXII

NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE
MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD CERTAIN OTHER
MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Electrical Engineering	1
Mathematics	1
Social Studies	1
No Minor Subjects	4
Two or More Minor Areas	1
Total Number of Teachers in this Category	6

Even in the largest county high schools, there were few individuals who taught physics a major portion of their teaching day. Actually there were few county high schools which had as many as two sections of physics, meaning that in instances in which a teacher is listed as having this subject as a major area, the teacher either is in administration, supervision, or is a part-time teacher.

TABLE CXXXIII

NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE
MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD CERTAIN OTHER
MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	4
General Science	1
Seventh and Eighth Grade Science	1
Mathematics	2
Social Studies	1
Industrial Arts	1
No Minor Subjects	5
Two or More Minor Areas	2
Total Number of Teachers in This Category	12

Teachers in the largest category of county schools whose major area of teaching was in chemistry were, for the most part, individuals whose teaching load was either entirely in chemistry or was in chemistry and some other science.

The succeeding table, Table CXXXIV shows that teachers of biology in this same category of schools (teachers whose major area of teaching was in biology) were also quite likely to be called upon to teach in other areas, particularly social studies and physical education. Percentagewise they were more likely to have two or more areas other than their major area of teaching than were the chemistry teachers represented in the preceding table.

TABLE CXXXIV

NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE
MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN OTHER
MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	2
Chemistry	1
General Science	10
Seventh and Eighth Grade Science	9
Conservation	1
Mathematics	5
Social Studies	14
English	1
Foreign Language	1
Industrial Arts	2
Commercial Subjects	2
Agriculture	1
Physical Education	10
Driver Training	1
No Minor Subjects	8
Two or More Minor Areas	18
Total Number of Teachers in this Category	47

TABLE CXXXV

NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE
MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN
OTHER MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	11
Chemistry	12
Biology	12
Seventh and Eighth Grade Science	18
Senior Science	1
Practical Science	1
Photography	1
Mathematics	8
Social Studies	12
English	2
Foreign Language	1
Commercial Subjects	1
Agriculture	1
Physical Education and Health	9
Music	1
No Minor Subjects	8
Two or More Minor Areas	31
Total Number of Teachers in this Category	64

As with the biology teachers represented in Table CXXXIV, so with the teachers of general science represented in this table (Table CXXXV), there was considerable evidence that they were called upon to teach quite a variety of subjects. Although they were much more likely to be teaching the remaining portion of the day in science subjects than were the teachers in the smaller categories of subjects, particularly social studies, physical education, and mathematics. The fact that only eight of this group of 64 teachers were teaching no other subjects and that almost half were teaching two or more subjects other than general science indicates that the general science teachers still were likely to be more "generalized" in their teaching than were some other teachers.

TABLE CXXXVI

NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS MATHEMATICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	23
Chemistry	8
Biology	3
General Science	9
Seventh and Eighth Grade Science	3
Senior Science	1
Other (non-science) Minor Areas	7
Number Teaching in Two or More Science Areas	9
Total Number of Teachers in this Category	37

Conditions determined for the smaller categories of schools with regard to mathematics teachers were borne out still further in the preceding table. By and large, those mathematics teachers who were teaching science were more likely than not to be teaching physics.

TABLE CXXXVII

NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS SOCIAL STUDIES AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	1
Biology	2
General Science	2
Seventh and Eighth Grade Science	1
Senior Science	1
Physiology	1
Conservation	1
Other (non-science) Minor Areas	1
Number Teaching in Two or More Science Areas	1
Total Number of Teachers in this Category	8

The striking thing about Table CXXXVII as compared with earlier tables is the difference that it indicates between the larger county schools and the schools in the other two categories

with respect to those teachers who were devoting the major portion of their teaching time to the social sciences. In this group of schools the number has taken a very sharp drop, and in no science were there more than two individuals teaching who might be said to be "social science majors" so far as their teaching day is concerned. A further specialization of teaching in the larger schools is thus indicated. This table may be compared with Table C, which depicts the condition with regard to social studies' teachers in the smallest category of county schools.

TABLE CXXXVIII

NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS HOME ECONOMICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	5
General Science	2
Seventh and Eighth Grade Science	1
Other(non-science) Minor Areas	1
Number Teaching in Two or More Science Areas	2
Total Number of Teachers in this Category	6

Although not very likely to be teaching classes in science, the home economics teachers in the larger county schools were more likely to be teaching biology than any other area. Only six individuals were represented, which is a very small proportion of

the total number of women teaching home economics a major portion of the time in the schools of this category.

TABLE CXXXIX

NUMBER OF TEACHERS IN OHIO'S LARGER COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS ENGLISH AND WHO HAD CERTAIN MINOR AREAS OF TEACHING IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Chemistry	1
Biology	6
Physiology	1
Other (non-science) Minor Areas	3
Total Number of Teachers in this Category	8

As with the other classes of schools, English teachers were unlikely to be teaching science subjects. Those who were, as may be seen in Table CXXXIX were likely to be teaching biology.

Distribution of Science Teachers

The following table presents in more compact form the distribution of science teachers in the larger county schools of Ohio according to the area in which they spent a major portion of their teaching time. It is comparable to similar tables given earlier for the smaller schools.

TABLE CXLII

DISTRIBUTION OF SCIENCE TEACHERS IN THE LARGER COUNTY HIGH SCHOOLS OF OHIO, WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR PORTION OF THEIR TEACHING TIME

Major Area of Teaching	Number of Teachers	Per cent of Total Group
Science Combination	67	23.76
Physics	6	2.13
Chemistry	12	4.26
Biology	47	16.67
General Science	64	22.69
Eighth Grade Science	1	0.35
Mathematics	37	13.12
Social Studies	8	2.83
Home Economics	6	2.13
English	8	2.83
Foreign Language	3	1.06
Health and Physical Education	19	6.74
Industrial Arts	3	1.06
Driver Training	1	0.35
Total Science Majors	197	69.84
Total Non-Science Majors	85	30.12
Totals	282	100.00

This table indicates a much lower percentage of teachers who were teaching "science combination" as their major field, a much higher percentage of teachers who were teaching a major portion of their time in the individual sciences, and, for the most part, a much lower percentage of individuals teaching science who were teaching in some other area a major portion of the day than do tables concerned with the smaller schools.

Number of Preparations and Number of
Classes

The two following tables, number CXLIII and CXLIV indicate the number of preparations required of each teacher in the larger county high schools, and the number of classes taught per day by each. This group of teachers appears to have been in a much more favorable position, insofar as number of preparations was concerned than their counterparts in the smaller schools. Whereas the teachers in the smallest group found some 24 per cent of their number with six or more preparations, and the next larger group had 14 per cent of their group so engrossed, with this group of teachers the percentage dropped to less than two and one-half per cent. Another factor indicating improvement in the general situation is that approximately sixty per cent of this group of teachers had three or less preparations per day, with both the median and the mode standing at three preparations daily.

TABLE CXLIII

NUMBER OF SEPARATE PREPARATIONS PER DAY BY 287* SCIENCE TEACHERS
IN THE LARGER SECONDARY SCHOOLS OF OHIO'S COUNTIES

Number of Preparations per Day	Number of Teachers	Per cents
1	23	8.01
2	48	16.72
3	99	34.49
4	77	26.83
5	33	11.49
6	6	2.09
7	1	0.35
Totals	287	100.00

*

Compares with 282 teachers in the preceding tables. This discrepancy occurs because sketchy teaching records caused five teachers to be omitted from the preceding tables.

TABLE CXLIV

NUMBER OF DIFFERENT CLASSES TAUGHT PER DAY BY 287 SCIENCE TEACHERS
IN THE LARGER SECONDARY SCHOOLS OF OHIO'S COUNTIES

Number of Classes Taught per Day	Number of Teachers	Per cents
1	9	3.13
2	8	2.78
3	21	7.31
4	52	18.12
5	111	38.66
6	64	22.30
7	20	7.00
8	2	0.70
Totals	287	100.00

As with the other two groups of schools, the median and the mode with this group was five separate classes per day. The percentage differences between the various numbers of teachers teaching for the various numbers of peridos are not particularly significant.

Summary of the County High Schools

The following tables summarize the results which have been discussed in the first three sections of this chapter. They have been drawn to indicate the salient features of the data which apply to county high schools as a group.

TABLE CXLV

NUMBER OF SCIENCE TEACHERS IN THE COUNTY HIGH SCHOOLS OF OHIO WHO WERE TEACHING VARIOUS COMBINATIONS OF SECONDARY SCIENCES

Combinations of Subjects	Number of Teachers
General Science and Biology	107
General Science and Chemistry	41
General Science and Physics	74
General Science, Chemistry, and Physics	27
General Science, Biology, and Chemistry	33
General Science, Biology, and Physics	100
General Science, Biology, Chemistry, and Physics	11
Biology and Chemistry	17
Biology and Physics	23
Biology, Chemistry, and Physics	7
Chemistry and Physics	12
Number of Teachers Teaching only the Combinations listed	59
Number of Teachers Teaching the Combinations listed Plus Two or More Subjects or Areas other than Science	216
Total Number in this Category	451

Table CXLV indicates that of the entire group of teachers in the county schools who were teaching a major portion of their day in "science combination" area, the most popular combination was general science and biology, followed closely by general science, biology, and physics. Most of these latter teachers were in situations where only one teacher taught all of the science offered in the high school. Additionally, however, most of these teachers were teaching subjects in areas unrelated to science.

TABLE CXLVI

NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Seventh and Eighth Grade Science	13
Senior Science	1
Electrical Engines	1
Mathematics	9
Social Studies	11
English	3
Foreign Language	2
Industrial Arts	6
Commercial Subjects	2
Home Economics	1
Physical Education and Health	4
No Minor Subjects	20
Two or More Minor Areas	17
Total Number in this Category	48

The prevalence of the teaching principal in the field of physics in the county schools is shown in Table CXLVI. Practically all of the twenty teachers listed in this table as teaching no subject other than physics were school executives.

TABLE CXLVII

NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	5
General Science	1
Seventh and Eighth Grade Science	5
Mathematics	8
Social Studies	5
English	6
Industrial Arts	2
Physical Education	2
Music	1
No Minor Areas	16
Two or More Minor Areas	10
Total Number in this Category	38

Teaching executives again dominated the field of "chemistry only" teachers listed in Table CXLVII. Of the 16 in this bracket, practically all were principals or executive heads of schools.

TABLE CXLVIII

NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Chemistry	1
Physics	2
General Science	12
Seventh and Eighth Grade Science	19
Senior Science	44
Conservation	1
Mathematics	27
Social Studies	30
English	11
Foreign Language	4
Industrial Arts	6
Home Economics	2
Commercial Subjects	7
Agriculture	7
Physical Education and Health	31
Driver Education	2
Music	2
Art	3
No Minor Subjects	10
Two or More Minor Areas	50
Total Number in this Category	101

Teachers whose major area of teaching was biology were likely to teach almost any other subject in the curriculum. They were particularly likely to be teaching general science, seventh or eighth grade science, mathematics, social studies, and physical education, although there was a generous sprinkling of other subjects to be found.

TABLE CXLIX

NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	18
Chemistry	17
Biology	18
Seventh and Eighth Grade Science	51
Senior Science	6
Practical Science	1
Conservation	1
Physiology	1
Photography	1
Mathematics	32
Social Studies	40
English	14
Foreign Language	2
Industrial Arts	11
Home Economics	3
Commercial Subjects	3
Agriculture	4
Physical Education and Health	39
Driver Education	4
Music	2
No Minor Subjects	8
Two or More Minor Areas	92
Total Number in this Category	142

Teachers in the county schools who were teaching general science a major portion of their time were very likely to be teaching almost any other science, and almost any other subject in the curriculum. In science, they were most likely to be teaching seventh and eighth grade science, while in other areas they were likely to be teaching social studies, physical education, mathematics, English, and industrial arts.

TABLE CL

NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS MATHEMATICS AND WHO HAD MINOR AREAS IN SCIENCE TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	153
Chemistry	43
Biology	41
General Science	107
Senior Science	7
Conservation	1
Seventh and Eighth Grade Science	33
Aeronautics	1
Other (non-science) Minor Areas	87
Two or More Science Areas	97
Total Number in this Category	270

County teachers whose major area of teaching was mathematics were especially likely to be teaching physics. Of 270 such

teachers, 153 or considerably more than half were teaching physics. The next largest number, 107, were teaching general science, with lesser numbers in chemistry and biology.

TABLE CLI

NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS SOCIAL STUDIES AND WHO HAD MINOR AREAS IN SCIENCE TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	13
Chemistry	4
Biology	64
General Science	63
Seventh and Eighth Grade Science	28
Senior Science	3
Botany	1
Physiology	3
Conservation	2
Other (non-science) Minor Areas	91
Two or More Science Areas	38
Total Number in this Category	139

Teachers in Ohio's county high schools who were teaching social studies a major portion of their time and who also were teaching some science were very likely to be teaching either biology, general science or both. They were much less likely to be teaching any of the other sciences.

TABLE CLII

NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS HOME ECONOMICS AND WHO HAD MINOR AREAS IN SCIENCE TEACHING

Minor Areas of Teaching	Number of Teachers
Chemistry	7
Biology	40
General Science	23
Seventh and Eighth Grade Science	11
Other (non-science) Minor Areas	44
Two or More Science Areas	15
Total Number in this Category	64

While home economics teachers in Ohio's county high schools were not particularly likely to be teaching in the science area, those who did teach some science were very likely to be teaching biology. They were somewhat likely to be teaching general science.

TABLE CLIII

NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS AGRICULTURE AND WHO HAD MINOR AREAS IN SCIENCE TEACHING.

Minor Areas of Teaching	Number of Teachers
Physics	1
Biology	2
General Science	1
Other (non-science) Minor Areas	4
Total Number in this Category	4

The number of agriculture teachers who were teaching science in the county schools was, as shown in Table CLIII, negligible.

TABLE CLIV

NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS ENGLISH AND WHO HAD MINOR AREAS IN SCIENCE TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	8
Chemistry	4
Biology	29
General Science	9
Seventh and Eighth Grade Science	6
Physiology	2
Other (non-science) Minor Areas	26
Two or more Science Areas	12
Total Number in this Category	45

Considering the fact that almost every county school in the state has at least one person who spends a majority of his time teaching English, the number of English teachers who also were teaching some science was very low. Only 45 individuals were in this category, and of these by far the greatest number were teaching biology, as shown in Table CLIV.

TABLE CLV

NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS FOREIGN LANGUAGE AND WHO HAD MINOR AREAS IN SCIENCE TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	2
Chemistry	2
Biology	12
General Science	9
Physiology	2
Other (non-science) Minor Areas	7
Two or More Science Areas	3
Total Number in this Category	23

Much the same condition holds for foreign language teachers in the county schools as for English teachers. Few were teaching science, and of these few, the greater number were in the field of biology.

TABLE CLVI

NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS PHYSICAL EDUCATION OR HEALTH AND WHO HAD MINOR AREAS IN SCIENCE TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	5
Chemistry	2
Biology	34
General Science	23
Seventh and Eighth Grade Science	20
Senior Science	2
Physiology	1
Other (non-science) Minor Areas	41
Two or More Science Areas	26
Total Number in this Category	58

As noted in Table CLVI, county teachers who were classed as physical education teachers and who also taught some science were much more likely to be found teaching biology, general science, and seventh and eighth grade science than other sciences. A relatively larger number of teachers were found in this category than in the two preceding.

TABLE CLVII

NUMBER OF TEACHERS IN OHIO'S COUNTY SCHOOLS WHOSE MAJOR AREAS OF TEACHING WAS COMMERCIAL AND WHO HAD MINOR AREAS IN SCIENCE TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	3
Chemistry	2
Biology	11
General Science	5
Senior Science	1
Other (non-science) Minor Areas	11
Two or More Science Areas	3
Total Number in this Category	19

While not many business or commercial teachers also teach science, there were some who did. As with other non-science major teachers, most who taught science were found in the area of biology, with the next highest group in general science.

TABLE CLVIII

NUMBER OF TEACHERS IN OHIO'S COUNTY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS INDUSTRIAL ARTS AND WHO HAD A MINOR AREA IN SCIENCE TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	12
Chemistry	4
Biology	18
General Science	24
Seventh and Eighth Grade Science	13
Senior Science	2
Aeronautics	1
Other (non-science) Minor Areas	28
Two or More Science Areas	17
Total Number in this Category	53

Table CLVIII indicates that there was a fairly large number of industrial arts teachers who also were teaching some science. This group of men had a larger percentage of physics teachers than did any other group of teachers aside from those in the sciences and in mathematics. An even larger number were teaching in general science, biology, and seventh and eighth grade science.

Who Teaches Science in the County Schools

One of the rather striking features of the preceding tables has to do with the amount of science taught by teachers whose major areas of teaching were in fields other than science. A glance at the various tables will show, for example, that physics

was taught two-thirds as frequently by non-science teachers as by science teachers if we can accept the major area of teaching load as being indicative of major interest and preparation of the non-science majors, most of the physics was taught by mathematics teachers. Other features as well are indicated in Table CLIX.

TABLE CLIX

NUMBER OF TIMES THE FOUR MAJOR SCIENCES WERE MENTIONED IN THE TEACHING AREAS OF THOSE TEACHING SCIENCE A MAJOR PORTION OF THEIR TIME AND THOSE TEACHING IT A MINOR PORTION OF THEIR TIME IN OHIO'S COUNTY HIGH SCHOOLS*

Subjects	Occurrence Among Science Teaching Majors	Occurrence Among Non-Science Teaching Majors
Physics	300	197
Chemistry	204	68
Biology	417	323
General Science	406	229
Totals	1327	817

*

Note that these totals are not true totals of teachers in the various schools, since the person teaching physics may also be teaching chemistry, thus may appear in the table more than once.

Number of Preparations and Number of Classes Taught

The following tables summarize the information relating to number of preparations per day by teachers in the county schools, also that relating to number of classes taught.

TABLE CLX

NUMBER OF PREPARATIONS REQUIRED OF 1474 SCIENCE TEACHERS IN
OHIO'S COUNTY HIGH SCHOOLS

Number of Preparations	Number of Teachers	Per cent
1	51	3.46
2	124	8.41
3	241	16.35
4	378	25.64
5	445	30.19
6	202	13.70
7	28	1.90
8	5	0.35
Totals	1474	100.00

A little over one-fourth of Ohio's county high school teachers who taught one or more classes of science had three preparations or fewer. A little over one-half had four preparations or less, while approximately one-sixth had six preparations or more per day.

TABLE CLXI

NUMBER OF CLASSES TAUGHT PER DAY BY 1474 OF OHIO'S HIGH SCHOOL
TEACHERS IN THE COUNTY SYSTEMS WHO TAUGHT ONE OR MORE CLASSES OF
SCIENCE

Number of Classes	Number of Teachers	Per cent
1	37	2.51
2	72	4.88
3	118	8.00
4	251	17.03
5	537	36.42
6	356	24.15
7	83	5.70
8	20	1.36
Totals	1474	100.00

The median and the mode in the county schools, so far as number of classes taught is concerned stood at five per day. This situation prevailed in the face of the fact that many (216) of the teachers represented were in fact teaching principals who taught usually one or two classes per day. Also to be kept in mind is the fact that many of the science classes were in reality double-period or seven-period-a-week classes, thus the picture is not quite fair to the science classroom teacher who was teaching double-period sections.

Exempted Village Schools

The teaching principal also was a factor in the exempted village schools. Of the 84 exempted village high schools whose records were examined, in 19 cases (22.6 per cent) the principal was also a teacher of science.

Because of the small number of exempted village schools, data relating to them has been treated all together, rather than making a division according to the sizes of the schools concerned. Not that all exempted village schools are of a similar size. The largest had a pupil population of 1223, while the smallest senior high school enrollment recorded in this division was 160.

Thus the smallest exempted village school was much smaller in pupil enrollment than the largest county schools, while the largest exempted village high school is much larger than many city high schools.

Because the average exempted village high school is quite a bit larger than the average county school, certain conditions prevailed which permitted these schools to be considered as a unit group. First, it was possible in most instances to determine a major subject for science teachers, rather than grouping them together into combination science majors as often was necessary with the county teachers. Thus the classification represented by such tables as Table CXIII was not a necessary part of the treatment of exempted village teachers. Similarly the number of

exempted villages having only one science teacher was not great enough to have particular significance, hence was omitted.

Data relative to the major areas of teaching of the exempted village teachers have been given in the following tables:

TABLE CLXII

EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS PHYSICS,
AND WHO HAD CERTAIN OTHER MINOR TEACHING AREAS

Minor Areas of Teaching	Number of Teachers
Chemistry	5
General Science	4
Seventh and Eighth Grade Science	3
Physical or Senior Science	2
Aeronautics	1
Mathematics	3
Social Studies	1
Commercial Subjects	1
Driving	1
Agriculture	1
No Minor Areas	1
Two or More Minor Areas	7
Total Number of Teachers in this Category	15

In general, teachers in the exempted village schools who were teachers of physics as a major area also were teachers of other sciences or else taught no subject other than physics. The total number of teachers considered in each of the categories in the exempted village schools is much lower than in the various

classes of county schools, since the exempted village schools constitute such a small group of schools in Ohio.

TABLE CLXIII

EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY,
AND WHO HAD CERTAIN OTHER MINOR TEACHING AREAS

Minor Area of Teaching	Number of Teachers
Physics	8
Biology	1
General Science	5
Physical or Senior Science	2
Seventh and Eighth Grade Science	2
Mathematics	4
Social Studies	2
Driver Training	1
No Minor Subjects	5
Two or More Minor Areas	8
Total Number of Teachers in this Category	22

As with teachers whose major area of teaching was in physics, the exempted village teachers whose major area was in chemistry were for the most part, see preceding table, teachers of other sciences.

This trend marks the exempted village teachers sharply from the teachers in the greater number of county schools.

TABLE CLXIV

EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN MINOR TEACHING AREAS

Minor Areas of Teaching	Number of Teachers
Physics	9
Chemistry	7
General Science	14
Seventh and Eighth Grade Science	6
Physiology	1
Aeronautics	1
Mathematics	7
Social Studies	10
English	2
Foreign Language	1
Industrial Arts	4
Physical Education and Health	7
Driver Training	3
No Minor Subjects	4
Two or More Minor Areas	21
Total Number of Teachers in this Category	51

While exempted village teachers who were teaching a major portion of the day in the area of biology also were likely to have certain other areas, these areas were more likely to be science areas than in the case of the county teachers as a whole. In the exempted villages, the biology teacher was, however, likely also to be a social studies' teacher or a mathematics teacher.

TABLE CLXV

EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN MINOR TEACHING AREAS

Minor Areas of Teaching	Number of Teachers
Physics	18
Chemistry	17
Biology	15
Seventh and Eighth Grade Science	13
Physical and Senior Science	3
Mathematics	13
Social Studies	8
Industrial Arts	2
Commercial Subjects	1
Physical Education and Health	6
Agriculture	1
No Minor Subject	4
Two or More Minor Areas	33
Total Number of Teachers in this Category	57

As with the county schools, the teacher of general science was likely to be teaching in almost any other field. In general, the range was narrower, however, in this respect than in the county schools. Much of the physics, chemistry, biology, and seventh and eighth grade science was taught by teachers who spent the major portion of the day teaching general science. This fact does not mean, necessarily, that the individual was a trained

general science teacher. It probably means that even though a teacher were trained predominantly in chemistry, physics, or biology, there still are more classes of general science in the average school than there are of the more specialized sciences.

One category was required in dealing with exempted village teachers which was not required in the county group, namely that of teachers who taught a major portion of their time in physical or senior science. These data are shown in the following table, Table CLXVI.

TABLE CLXVI

EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS SENIOR
OR PHYSICAL SCIENCE AND WHO HAD CERTAIN MINOR TEACHING AREAS

Minor Areas of Teaching	Number of Teachers
General Science	1
Seventh and Eighth Grade Science	1
Mathematics	1
Physical Education and Health	1
Two or More Minor Areas	1
Total Number of Teachers in this Category	3

TABLE CLXVII

EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS
MATHEMATICS AND WHO HAD CERTAIN MINOR AREAS OF SCIENCE
TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	22
Chemistry	10
Biology	2
General Science	7
Senior or Physical Science	1
Seventh and Eighth Grade Science	4
Two or More Science Areas	12
Total Number of Teachers in this Category	32

As with the county schools, teachers whose major area of teaching was in mathematics were, when teaching science, quite likely to be teaching physics. They also were very likely to be in the area of chemistry, and rather less likely to be teaching general science.

TABLE CLXVIII

EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS
SOCIAL STUDIES AND WHO HAD CERTAIN MINOR AREAS OF
SCIENCE TEACHING

Minor Areas of Teaching	Number of Teachers
Chemistry	1
Biology	5
General Science	1
Total Number of Teachers in this Category	7

Social studies teachers in the exempted village schools, see Table CLXVIII were not very likely to be teaching any science. Only seven such teachers in all of the exempted villages of the state were teaching even one area of science. Those who were, for the most part taught biology.

TABLE CLXIX

EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS HOME
ECONOMICS AND WHO HAD CERTAIN MINOR AREAS OF SCIENCE TEACHING

Minor Areas of Teaching	Number of Teachers
General Science	1
Total Number of Teachers in this Category	1

TABLE CLXX

EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS ENGLISH
AND WHO HAD CERTAIN MINOR AREAS OF SCIENCE TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	2
Chemistry	1
Biology	2
Two or More Science Areas	2
Total Number of teachers in this Category	3

TABLE CLXXI

EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS FOREIGN
LANGUAGES AND WHO HAD CERTAIN MINOR AREAS OF SCIENCE TEACHING

Minor Areas of Teaching	Number of Teachers
Biology	1
Total Number of Teachers in this Category	1

TABLE CLXXII

EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS HEALTH
OR PHYSICAL EDUCATION AND WHO HAD CERTAIN MINOR AREAS OF SCIENCE
TEACHING

Minor Areas of Teaching	Number of Teachers
Chemistry	2
Biology	8
General Science	6
Two or More Science Areas	2
Total Number of Teachers in this Category	13

TABLE CLXXIII

EXEMPTED VILLAGE TEACHERS WHOSE MAJOR AREA OF TEACHING WAS
INDUSTRIAL ARTS AND WHO HAD CERTAIN MINOR AREAS OF SCIENCE
TEACHING

Minor Areas of Teaching	Number of Teachers
Biology	1
Total Number of Teachers in this Category	1

The preceding group of five tables bears out the general finding that teachers whose major areas of teaching are not in science teach very little science in the exempted village schools. Except for the physical education teachers represented in Table CLXXII, there were but six teachers represented in all of these areas. Again, the physical education teachers were quite likely to be teaching biology.

Additional Teachers

In addition to the teachers listed in the preceding tables, one teacher taught Electricity and Radio as a major subject and taught it with no minors. Because of the nature of this case it has not been tabulated, but was taken into consideration in dealing with the exempted village science teachers as a whole.

One item which was apparent in making a comparison between the teachers of the exempted villages and those of the county schools is the greater amount of specialization exhibited by the teachers of the exempted villages insofar as their teaching area

was concerned. This item appears in a later table.

Preparation and Class Load

Both the mean and the median number of preparations required of the science teacher in the exempted village schools was three. The highest number was six, compared with eight in the county schools. The number of classes taught per day did not appear to vary greatly as between the county and the exempted village schools. In both cases the mean and the median was five classes per day.

Data relative to these two items may be found in Tables CLXXIV and CLXV.

TABLE CLXXIV

NUMBER OF PREPARATIONS PER DAY REQUIRED OF SCIENCE TEACHERS IN
THE EXEMPTED VILLAGE SCHOOLS OF OHIO

Number of Preparations	Number of Teachers	Per cent
1	16	7.73
2	60	28.98
3	74	35.75
4	45	21.74
5	11	5.32
6	1	0.48
Totals	207	100.00

TABLE CLXXV

NUMBER OF CLASSES TAUGHT PER DAY BY 207 EXEMPTED VILLAGE SCIENCE
TEACHERS IN OHIO

Number of Classes	Number of Teachers	Per cent
1	9	4.36
2	11	5.32
3	13	6.28
4	45	21.74
5	82	39.61
6	36	17.44
7	9	4.36
8	2	0.96
Totals	207	100.00

TABLE CLXXVI

DISTRIBUTION OF SCIENCE TEACHERS IN THE EXEMPTED VILLAGE SCHOOLS
OF OHIO WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE
MAJOR PORTION OF THEIR TEACHING TIME

Major Area of Teaching	Number of Teachers	Per cent of total group
Physics	15	7.25
Chemistry	22	10.64
Biology	51	24.64
General Science	57	27.53
Senior Science, etc.	3	1.45
Electricity, etc.	1	0.48
Mathematics	32	15.46
Social Studies	7	3.40
Home Economics	1	0.48
English	3	1.45
Foreign Language	1	0.48
Health and Physical Education	13	6.28
Industrial Arts	1	0.48
Total Science Majors	149	71.99
Total Non-Science Majors	58	28.03
Totals	207	100.00

Comparison of the preceding table with Tables CVIII, CXXVII and CXLII indicates that the exempted village teachers were located more specifically in science than was the case in any of the categories of county schools.

This same conclusion may be drawn from Table CLXXVII when comparison is made with Table CLIX which contains comparable data for county schools.

TABLE CLXXVII

NUMBER OF TIMES THE FOUR MAJOR SCIENCES WERE MENTIONED IN THE TEACHING AREAS OF THOSE TEACHING SCIENCE A MAJOR PORTION AND THOSE TEACHING IN A MINOR PORTION OF THEIR TIME IN OHIO'S EXEMPTED VILLAGE SCHOOLS

Subjects	Occurrence Among Science Teaching Majors	Occurrence Among Science Teaching Minors
Physics	50	24
Chemistry	51	14
Biology	67	19
General Science	81	15
Totals*	249	72

* As in Table CLIX, and for the same reason, these figures do not represent total number of teachers.

Probably more succinctly than any other table, Table CLXXVII indicates the greater specialization of teachers of science in the exempted village schools as compared with those in the county systems.

A comparison of the preceding table with Table CLIX indicates the difference to be found between county teachers as a whole and exempted village teachers in this respect.

The City Schools

Because of the great variation in pupil enrollment per grade in the city schools, they have been classified into four categories as follows: 1 - 100 pupils per grade; 101 - 200 pupils per grade; 201 - 300 pupils per grade; over 300 pupils per grade.

Of the 163 city high schools studied, 23 belong in the category of those having fewest pupils, 56 are in the next group, 35 in the third, and 49 in the group having the largest number of pupils per grade. The teachers of the junior high schools have been included in these listings, but the junior high schools themselves have not been counted separately. This arrangement was carried out because only the ninth year of the junior high schools was included in the work of the study. There were, however, 102 junior high schools included in the listings insofar as their ninth grade science teachers were concerned. The varied arrange-

ments of senior, four-year, six-year, and even two-year high schools makes a simple pattern of classification difficult. Since the only real need for a count of the schools themselves lay in attempting to determine breadth of curriculum, and since the junior highs added little to this picture, they have not been included in the divisional classification. All data concerning their ninth-grade science teachers have been included, however.

The same treatment was given in the county and exempted village schools. In these instances, however, the incidence of junior high schools was quite small, and did not become noticeable in any type of calculation needed for purposes of a study such as this one.

Data concerning the city schools have been handled as nearly as possible in a fashion similar to that used with the county and exempted village schools, and are set forth on the following pages:

TABLE CLXXVIII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD CERTAIN
MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Chemistry	3
General Science	2
Aeronautics	1
Physiology	1
Mathematics	1
Driver Training	1
Two or More Minor Areas	3
Total Number of Teachers in this Category	4

TABLE CLXXIX

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD CERTAIN
MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	9
General Science	5
Mathematics	4
English	1
Two or More Minor Areas	7
Total Number of Teachers in this Category	12

Tables CLXXVIII and CLXXIX indicate a greater amount of specialization in the group of city teachers under consideration than has been seen in dealing with earlier groups. Aside from mathematics, the number of non-science subjects taught by the 16 teachers represented in the two preceding tables is very small.

TABLE CLXXX

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE)
 WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN
 MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	2
Chemistry	4
General Science	10
Physical or Senior Science	1
Mathematics	2
Social Studies	3
Foreign Language	1
English	3
Agriculture	1
Driver Training	1
No Minor Subject	2
Two or More Minor Areas	8
Total Number of Teachers in this Category	22

As with other categories of teachers, city teachers in this classification who taught biology a major portion of their time were likely also to be teaching general science. By and large they were teaching a wider variety of subjects than were the teachers whose major areas were in chemistry and physics. They were, however, teaching little else except science.

TABLE CLXXXI

TEACHERS IN OHIO'S CITY SCHOOLS (1-100 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	2
Chemistry	2
Biology	2
Physical or Senior Science	1
Seventh and Eighth Grade Science	7
Mathematics	10
Social Studies	4
Commercial Subjects	1
Home Economics	1
Driver Training	1
Physical Education and Health	3
No Minor Areas	1
Two or More Minor Areas	11
Total Number of Teachers in this Category	21

General science teachers, see Table CLXXXI, like biology teachers, were somewhat likely to be teaching a variety of subjects. They were more likely to be teaching mathematics and seventh and eighth grade science than any other subject areas. Four of the 21 were teaching social studies, and three were physical education teachers.

TABLE CLXXXII

TEACHERS IN OHIO'S CITY SCHOOLS (1-100 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS MATHEMATICS AND WHO HAD CERTAIN MINOR SCIENCE AREAS

Minor Areas of Teaching	Number of Teachers
Physics	2
Chemistry	2
General Science	2
Senior or Physical Science	1
Two or More Science Areas	1
Total Number of Teachers in this Category	6

The preponderance of mathematics teachers who were teaching physics as a minor area was broken in this category of schools. Only six mathematics teachers were teaching any science, and of these, only two were teaching physics.

TABLE CLXXXIII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS SOCIAL STUDIES AND WHO HAD
CERTAIN MINOR SCIENCE AREAS

Minor Areas of Teaching	Number of Teachers
Physics	1
Chemistry	1
Two or More Science Areas	1
Total Number of Teachers in this Category	1

TABLE CLXXXIV

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (100 PUPILS PER GRADE) WHOSE
MAJOR AREA OF TEACHING WAS INDUSTRIAL ARTS AND WHO HAD CERTAIN
MINOR SCIENCE AREAS

Minor Areas of Teaching	Number of Teachers
Biology	1
Number of Teachers in this Category	1

TABLE CLXXXV

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE) WHOSE
MAJOR AREA OF TEACHING WAS PHYSICAL EDUCATION AND WHO HAD CERTAIN
MINOR SCIENCE AREAS

Minor Areas of Teaching	Number of Teachers
Biology	2
General Science	3
Total Number of Teachers in this Category	5

TABLE CLXXXVI

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS MUSIC AND WHO HAD CERTAIN MINOR
SCIENCE AREAS

Minor Areas of Teaching	Number of Teachers
Physics	1
Total Number of Teachers in this Category	1

Tables CLXXXIII, CLXXXIV, and CLXXXVI carry out further the thesis of the first paragraph of this section concerning the city schools. These four tables show that only a small handful of teachers whose major areas of teaching are in on-science subjects actually were teaching any science in these schools. While in this category there **was** a considerable number of teachers who were teaching two or three sciences, there were relatively few who were teaching some science while at the same time teaching most of the time in some other subject-matter area.

TABLE CLXXXVII

DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S CITY HIGH SCHOOLS
(1-100 PUPILS PER GRADE) WITH REGARD TO THE AREA OF TEACHING
WHICH REQUIRED THE MAJOR EXPENDITURE OF THEIR TEACHING TIME

Major Area of Teaching	Number of Teachers	Per cent of total group
Physics	4	5.48
Chemistry	12	16.44
Biology	22	30.14
General Science	21	28.77
Mathematics	6	8.22
Social Studies	1	1.37
Industrial Arts	1	1.37
Physical Education	5	6.85
Music	1	1.37
Total Science Majors	59	80.83
Total non-science Majors	14	19.18
Totals	73	100.00

Table CLXXXVII indicates that in the city schools, even those of the smallest category, science seems to have been taught predominantly by individuals who spent the major portion of their time in science teaching. There appears to have been a greater amount of specialization in this area, and a correspondingly smaller group teaching in more than one minor area.

These factors are shown also in the following two tables which deal with preparations per day and number of classes taught per day by the teachers in the smaller city high schools of Ohio.

TABLE CLXXXVIII

NUMBER OF PREPARATIONS REQUIRED DAILY OF 73 SCIENCE TEACHERS IN OHIO'S CITY SCHOOLS (1-100 PUPILS PER GRADE)

Number of Preparations	Number of Teachers	Per cent of total
1	5	6.85
2	27	36.98
3	28	38.35
4	11	15.07
5	1	1.37
6	0	0.00
7	1	1.37
Totals	73	100.00

TABLE CLXXXIX

NUMBER OF DIFFERENT CLASSES TAUGHT PER DAY BY 73 SCIENCE TEACHERS
IN OHIO'S CITY HIGH SCHOOLS (1-100 PUPILS PER GRADE)

Number of Classes	Number of Teachers	Per cent of total
1	0	0.00
2	1	1.37
3	3	4.11
4	19	26.03
5	31	42.46
6	14	19.18
7	5	6.85
Totals	73	100.00

In the matter of preparations, a very considerable difference existed between conditions in the county schools and in even the smallest group of city schools. Both the median and the mode in city schools stood at three preparations per day, with almost as many teachers having had two preparations per day as had three. Only one teacher in this class of schools had more than five preparations, and only two had more than four. On the other hand, there were five who had only one preparation. As with other schools so far tabulated, the median number of classes taught per day was five. There were no teachers who had only one class per day as in the county schools, since in this group of schools the teaching principal was not a factor. A few teachers

have part-time administrative, supervisory, or guidance work, however, and thus taught less than a full day. These individuals are represented chiefly by the four individuals teaching either two or three classes per day.

City High Schools (101-200 per Grade)

Quite a large body of teachers was found in the schools of this category in the State of Ohio. In general, tabular treatment of data similar to that which has gone before indicated a further specialization in teaching area. A few subjects were found with this group of schools which were much less likely to be found among the smaller schools, thus probably representing a broader program of studies, which is a condition to be expected.

TABLE CXc

TEACHERS IN OHIO'S CITY SCHOOLS (101-200 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Chemistry	2
General Science	3
Mathematics	5
English	1
Health and Physical Education	2
Driver Training	4
Two or More Minor Areas	2
Total Number of Teachers in this Category	14

There is little in Table CXC to distinguish the physics teachers in this category of schools from physics teachers in the next smaller classification. Most were teachers of other science subjects or or mathematics. None were teachers of biology. One trend which has become somewhat noticeable is that several were teachers of Driver Education. This is a recent change, since this area was scarcely known in the curriculum prior to the close of World War II.

TABLE CXCI

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD CERTAIN
MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	20
Biology	2
General Science	9
Physical or Senior Science	5
Descriptive Chemistry	1
Elementary Science	2
Mathematics	6
Social Studies	2
English	1
Commercial	1
Aeronautics	1
Agriculture	2
Driver Training	2
Physical Education and Health	1
No Minor Subject	4
Two or More Minor Areas	17
Total Number of Teachers in this Category	38

Teachers whose major area of teaching was in chemistry taught a rather wide number of subjects as a group. While there were several such subjects represented, most of them were scientific in nature. Some subjects which entered here and which were not present in earlier tables included elementary science, and descriptive chemistry. The chemistry teacher was, in this group of schools, quite likely to be a teacher of general science or mathematics.

In general, in this category of teachers, it may be noted that the subjects taught by science teachers throughout this group of tables reflected more completely a placement of science teachers into a full day of science teaching, with proportionately fewer such teachers engaged in teaching social studies, English, foreign languages, and the other non-science areas of the curriculum.

TABLE CXCII

TEACHERS IN OHIO'S CITY HIGH SCHOOL (101-200 PUPILS PER GRADE)
 WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN
 MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	5
Chemistry	1
General Science	14
Physical or Senior Science	2
Practical Science	1
Elementary Science	8
Physiology	2
Mathematics	1
Social Studies	5
English	3
Foreign Language	1
Industrial Arts	1
Commercial Subjects	2
Agriculture	1
Health and Physical Education	7
Driver Training	1
Photography	1
No Minor Subjects	22
Two or More Minor Areas	8
Total Number of Teachers in this Category	70

TABLE CXCI

TEACHERS IN OHIO'S CITY SCHOOLS (101-200 PUPILS PER GRADE) WHOSE
MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD CERTAIN
MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	7
Chemistry	9
Physical or Senior Science	2
Elementary Science	17
Electricity	2
Aeronautics	1
Mathematics	10
Social Studies	8
English	1
Industrial Arts	3
Physical Education and Health	4
Driver Training	2
No Minor Subject	35
Two or More Minor Subjects	17
Number in this Category	79

A broadened curriculum and a greater tendency on the part of science teachers to be teaching science subjects are noticeable in Tables CXCI and CXCI. In addition, a third trend begins to make its appearance rather strongly. This is the trend which becomes so much more noticeable in the largest classification of schools -- that of having great numbers of teachers who teach one subject alone. In Table CXCI, for example, of the 70 teachers

represented, 22 taught only biology. In the next succeeding table, 35 of the 79 teachers taught no subject other than general science.

While the teacher of general science in schools of this category was still somewhat likely to be also a mathematics or a social studies teacher, and while biology teachers were somewhat likely to be physical education teachers, they were more likely to be just biology, or just general science teachers, or at most to be teaching in rather related areas of science.

TABLE CXCIV

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS PHYSICAL OR SENIOR SCIENCE AND
WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	2
Chemistry	1
General Science	1
Social Studies	1
No Other Subjects	1
Two or More Minor Areas	1
Total Number of Teaching in this Category	3

Three teachers in this category of schools were teaching a major portion of their time in physical or senior science. This fact shows a trend which may or may not be in the making -- that

of having a rather extensive program of senior science in the high school. While quite a number of schools have one or a few classes of work in one of these areas, a few schools have gone in this direction to the extent that a somewhat extensive program has been developed. Thus there were three teachers who were teaching for a major portion of their day in this subject area.

TABLE CXCv

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS IN MATHEMATICS AND WHO HAD CERTAIN
MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	5
Chemistry	3
Biology	1
General Science	4
Radio	1
Two or More Minor Areas in Science	1
Total Number of Teachers in this Category	14

A sprinkling of mathematics teachers were teaching one or more of the sciences in this category of schools. Of the 14 teachers thus situated, five were teaching physics, and three were teaching chemistry. One was teaching a subject which is somewhat unusual in the Ohio courses of study--radio.

TABLE CXCVI

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS SOCIAL STUDIES AND WHO HAD
CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	2
General Science	3
Total Number of Teachers in this Category	5

TABLE CXCVII

TEACHERS IN OHIO'S CITY SCHOOLS (101-200 PUPILS PER GRADE) WHOSE
MAJOR AREA OF TEACHING WAS IN ENGLISH AND WHO HAD CERTAIN MINOR
AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	2
General Science	1
Senior or Physical Science	1
Total Number of Teachers in this Category	4

TABLE CXCVIII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS FOREIGN LANGUAGE AND WHO HAD
MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	1
Total Number of Teachers in this Category	1

TABLE CXCIX

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS INDUSTRIAL ARTS AND WHO HAD
MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	1
Total Number of Teachers in this Category	1

TABLE CC

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS PHYSICAL EDUCATION AND WHO HAD
CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
General Science	1
Biology	1
Total Number of Teachers in this Category	2

TABLE CCI

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS ART AND WHO HAD CERTAIN MINOR
AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Chemistry	1
Biology	1
Advanced Science	1
Two or More Minor Areas of Science	1
Total Number of Teachers in this Category	1

TABLE CCII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS SEVENTH AND EIGHTH GRADE SCIENCE
AND WHO HAD CERTAIN MINOR AREAS

Minor Areas of Teaching	Number of Teachers
General Science	2
Advanced Science	1
Total Number of Teachers in this Category	3

Careful study of Tables CXCVI - CCII and a comparison of them with Tables CLI - CLVIII will show the extent to which specialization has entered the picture with an increase in pupil population of the schools. The preceding seven tables account for only 17 teachers in toto, certainly a small number in comparison with the similar figures found in the smaller categories of schools. With this group of schools, science teaching has become much more specialized in that not only were science teachers more likely to be teachers of science subjects alone, but they were more likely to be teaching one science subject.

TABLE CCIII

DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S CITY HIGH SCHOOLS
(101-200 PUPILS PER GRADE) WITH REGARD TO THE AREA OF TEACHING
WHICH REQUIRED THE MAJOR EXPENDITURE OF THEIR TEACHING TIME

Major Areas of Teaching	Number of Teachers	Per cent of total group
Physics	14	5.96
Chemistry	38	16.17
Biology	70	29.79
General Science	79	33.61
Senior Science	3	1.27
Seventh and Eighth Grade Science	3	1.27
Mathematics	14	5.96
Social Studies	5	2.13
English	4	1.70
Foreign Language	1	0.43
Industrial Arts	1	0.43
Physical Education	2	0.85
Art	1	0.43
Total Science Majors	207	88.07
Total Non-Science Majors	28	11.93
Totals	235	100.00

The preceding table shows quite a gain in specialization over the comparable figures for the smaller city schools. In the schools of the category discussed in the preceding table, 88.07 per cent of the teachers were teaching science as their major area of

teaching. In the group of smaller cities, on the other hand, the figure was between 80 and 81 per cent. This compares with between 45 and 46 per cent for the smallest county schools.

As shown above, a very large difference existed between the smallest county schools and any group of city schools in the percentage of teachers teaching at least one class of science who were engaged a major portion of their time in science teaching.

TABLE CCIV

NUMBER OF PREPARATIONS REQUIRED DAILY OF 235 SCIENCE TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE)

Number of Preparations	Number of Teachers	Per cent of total
1	60	25.53
2	100	42.55
3	57	24.26
4	18	7.66
Totals	235	100.00

TABLE CCV

NUMBER OF DIFFERENT CLASSES TAUGHT PER DAY BY 235 SCIENCE
TEACHERS IN OHIO'S CITY HIGH SCHOOLS (101-200 PUPILS PER GRADE)

Number of Classes	Number of Teachers	Per cent of total
1	3	1.27
2	7	2.98
3	11	4.68
4	75	31.91
5	104	44.26
6	30	12.77
7	4	1.70
8	1	0.43
Totals	235	100.00

Table CCIV indicates that just over a fourth of the teachers in this category had only one preparation per day. This contrasts greatly with the conditions in the smaller schools, and even more so when it is considered that there were no teaching principals in this group. Over two-thirds of these teachers had two or less preparations per day, while less than eight per cent had as many as four per day. No teacher in the classification had more than four preparations per day.

As with other categories of teachers, the median number of classes per day was five, however, there were over forty per cent of the teachers with less than five classes per day, while only a little less than fifteen per cent had more than five per day. In the preceding classification (cities with 1-100 pupils per grade) although the median number of classes taught per teacher was the same, there were only about 32 per cent teaching less than five classes and over 26 per cent teaching more than five classes.

City High Schools
(201-300 per Grade)

This category includes data concerning 193 teachers who during the school year 1950-51 were teaching one or more classes of science in city high schools of the enrollment noted. In general, trends which have developed concerning certain phases of the teaching continued to march in the same direction in the data presented herewith. Thus teachers tended to be more specialized in the subjects which they were required to teach, and the number of preparations again showed a sharp reduction. Data concerning the 193 teachers in this category have been presented in tabular form in the following pages.

TABLE CCVI

TEACHERS IN OHIO'S CITY SCHOOLS (201-300 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD THE FOLLOWING MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Chemistry	4
Biology	1
General Science	3
Physical Science	6
Conservation	1
Personal Science	1
Photography	1
Mathematics	6
English	1
Driver Training	1
No Other Subject	3
Two or More Minor Areas	5
Total Number of Teachers in this Category	23

TABLE CCVII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE) WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD THE FOLLOWING MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	6
Biology	3
General Science	9
Physical or Senior Science	3
Elementary Science	1
Photography	1
Mathematics	2
Social Studies	2
English	1
Health or Physical Education	1
No Minor Subject	10
Two or More Minor Areas	6
Total Number of Teachers in this Category	31

Despite the trend toward specialization in the schools as the pupil population increased, the physics teachers in this category of schools taught a rather wide variety of subjects, as may be seen in Table CCVI. Only three of the twenty-three taught physics only. This results, no doubt, from the fact that even in high schools with relatively great populations we are likely to find only one or two sections of physics given.

In Table CCVII, while somewhat the same results have been shown for teachers of chemistry, there were, proportionately, a larger number of teachers who were teaching chemistry alone than was the case for physics. Almost one-third of these teachers taught only the one science. Most of the chemistry and the physics teachers were teaching only in science areas, although six teachers of physics were also teaching mathematics.

TABLE CCVIII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS BIOLOGY AND WHO HAD CERTAIN MINOR
AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
General Science	8
Physical or Senior Science	1
Eighth Grade Science	6
Physiology	1
Botany	1
Photography	1
Museum Training	1
Nature Study	1
Mathematics	2
Social Studies	5
English	2
Home Economics	1
Driver Training	1
Physical Education and Health	4
No Minor Subject	31
Two or More Minor Areas	3
Total Number of Teachers in this Category	63

TABLE CCIX

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS GENERAL SCIENCE AND WHO HAD
CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	3
Chemistry	1
Biology	2
Aeronautics	1
Elementary Science	9
Mathematics	4
Social Studies	7
Foreign Language	1
Commercial Subjects	1
Health and Physical Education	5
No Minor Subjects	21
Two or More Minor Areas	4
Total Number of Teachers in this Category	51

Teachers of biology and of general science followed even more definitely the trend which became apparent with the preceding category of teachers (those in the pupil-per-grade group of 101-200). Thus of the 63 teachers of biology, 31 were teaching no other subject, and almost all of the rest were teaching science subjects only. In general science, of the 51 teachers, 21 were teaching only general science.

Note that in this category of schools physiology, botany, museum training, and nature study have been found as variants of

the biological sciences. These probable, at least in some cases, represent efforts at a broadened curriculum.

TABLE CCX

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS PHYSICAL OR SENIOR SCIENCE AND
WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Social Studies	2
Physical Education and Health	1
Two or More Minor Areas	1
Total Number of Teachers in this Category	2

TABLE CCXI

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS PHYSIOLOGY, BOTANY, OR ZOOLOGY
AND WHO HAD CERTAIN MINOR AREAS

Minor Areas of Teaching	Number of Teachers
Social Studies	1
No Minor Subject	2
Total Number of Teachers in this Category	3

Tables CCV and CCXI indicate that in this category of schools there were at least a few teachers who taught a major portion of their time in physical or senior science, botany, zoology, and physiology. While the number is small, it is somewhat indicative

of conditions which exist in a few Ohio city high schools. In general, the areas of physiology, botany, and zoology represent situations in which the older college preparatory sciences have not been succeeded by the more general science of biology. The senior or physical sciences represent attempts on the part of curriculum makers to adjust the curriculum to the needs of non-college-bound youth.

TABLE CCXII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS MATHEMATICS AND WHO HAD CERTAIN
MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	2
Chemistry	1
Biology	1
General Science	3
Total Number of Teachers in this Category	7

TABLE CCXIII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS IN SOCIAL STUDIES AND WHO HAD
CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	1
Chemistry	1
Biology	2
Senior or Physical Science	1
Two or More Minor Areas	1
Total Number of Teachers in this Category	4

TABLE CCXIV

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS IN INDUSTRIAL ARTS OR VOCATIONAL
AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
General Science	2
Total Number of Teachers in this Category	2

TABLE CCXV

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS HEALTH OR PHYSICAL EDUCATION AND
WHO HAD MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	4
Botany	1
Total Number of Teachers in this Category	5

TABLE CCXVI

TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE)
WHOSE MAJOR AREA OF TEACHING WAS IN HOME ECONOMICS AND WHO HAD
MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	1
General Science	1
Total Number of Teachers in this Category	2

Tables CCXII - CCXVI show the continuing trend toward specialization. Whereas a few teachers whose major areas of teaching were in areas other than science have been included in these tables, by and large, in this category of schools, science was taught by science teachers. Only 20 teachers were found in all of these categories of non-science teaching as compared with 173 who definitely were science teachers.

TABLE CCXVII

DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S CITY HIGH SCHOOLS (201-300 PUPILS PER GRADE) WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR EXPENDITURE OF THEIR TEACHING TIME

Major Area of Teaching	Number of Teachers	Percentage of total
Physics	23	11.92
Chemistry	31	16.06
Biology	63	32.64
General Science	51	26.42
Senior or Physical Science	2	1.04
Physiology, Botany, and Zoology	3	1.55
Mathematics	7	3.62
Social Studies	4	2.07
Industrial Arts or Vocational	2	1.04
Physical Education and Health	5	2.59
Home Economics	2	1.04
Total Science	173	89.63
Total Non-Science	20	10.36
Totals	193	100.00

TABLE CCXVIII

DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S CITIES (201-300 PUPILS PER GRADE) WITH REGARD TO THE NUMBER OF PREPARATIONS REQUIRED PER DAY

Number of Preparations	Number of Teachers	Per cent of total
1	67	34.71
2	79	40.93
3	43	22.28
4	4	2.07

For the first time in the progression through the county schools, the exempted villages, and the cities, over one-third of the teachers were found to have only one preparation per day. Similarly, there were far fewer teachers with more than three preparations per day than in any earlier group. Over three-fourths of the teachers had two or less preparations per day.

This situation certainly has its significance as it pertains to teacher overload in the matter of an excessive number of preparations. The teacher with one or two preparations per day certainly has the opportunity to probe more deeply, to obtain more and perhaps more carefully selected teaching aids and devices. He has the opportunity to spend time in his laboratory in preparation which must be used (all other factors being equal) by less fortunate teachers in preparation of extra subjects. The fact that the teacher has so few preparations does not guarantee this thoroughness, it merely gives opportunity for it.

TABLE CCXIX

DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S CITY HIGH SCHOOLS
(201-300 PUPILS PER GRADE) WITH REGARD TO THE NUMBER OF CLASSES
TAUGHT PER DAY

Number of Classes	Number of Teachers	Per cent of total
1	0	0.00
2	3	1.55
3	17	8.81
4	63	32.64
5	69	35.74
6	39	20.21
7	1	0.52
8	1	0.52
Totals	193	100.00

Again in this group of teachers there was found an increase in the percentage of teachers who taught science of one form or another for a major portion of the day.

It is easy to see that the number of classes taught per day has changed less as the study has proceeded from one group of teachers to another, than has almost any other item. The median and the mode still stand at five classes taught per day, although there have been variations, percentage-wise in the relative numbers teaching more and less than five classes per day.

Ohio's Largest City High Schools (301 and Over
per Grade)

While there are relatively only a few high schools in this category, the factor of pupil enrollment in each one causes them to be quite an important group of schools in this study. There were only 49 of these schools represented, but there were 361 teachers whose records were on file and were interpreted in this investigation. The trends which were discovered earlier, in proceeding from small to large high schools continue, and further, a considerable number of subjects have been listed which did not appear in the curricula of the smaller high schools. Industrial chemistry, electronics, physiography, and metallurgy made their appearance, together with several others that have been noted in scattering numbers and locales.

This is the only category of schools having an appreciable number of teachers who presented major areas of teaching in physiology, botany, and zoology. Quite a sizeable number of teachers in these largest schools did present such a major area. Further, almost half of these teachers were teaching one of these subjects not only as a major area but as a sole area.

Data concerning these high schools have been presented in the following tabular fashion:

TABLE CCXX

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREAS
OF TEACHING WAS IN PHYSICS AND WHO HAD CERTAIN MINOR AREAS OF
TEACHING

Minor Areas of Teaching	Number of Teachers
Chemistry	6
Biology	4
General Science	6
Physical or Senior Science	4
Radio	1
Electronics	3
Photography	1
Elementary Science	2
Metallurgy	1
Aeronautics	2
Descriptive Chemistry	2
Practical Science	1
Mathematics	7
Social Studies	2
Driver Training	1
No Minor Subject	8
Two or More Minor Areas	10
Total Number of Teachers in this Category	41

TABLE CCXXI

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA
OF TEACHING WAS IN CHEMISTRY AND WHO HAD CERTAIN MINOR AREAS
OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	4
Biology	6
General Science	5
Physical or Senior Science	2
Industrial Chemistry	2
Elementary Science	2
Zoology	2
Photography	1
Mathematics	8
Social Studies	4
Industrial Arts	1
Health and Physical Education	1
No Minor Subject	29
Two or More Minor Areas	6
Total Number of Teachers in this Category	61

Even in the largest high schools in Ohio, physics teachers, for the most part, still had other subjects to teach. Thus only eight of the 41 teachers listed in Table CCXX taught only one subject, physics. On the other hand, 29 of the 61 chemistry teachers listed in Table CCXXI were teaching chemistry only. A glance at both tables shows the rather wide variety of sciences being taught by physics and by chemistry teachers. Metallurgy,

descriptive chemistry, photography, industrial chemistry, and practical science are some of those which have been added in the largest high schools and which have made their way into only a very scattered number of smaller schools. Some of these subjects have been found in none of the smaller schools.

TABLE CCXXII

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN BIOLOGY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	1
General Science	7
Physical or Senior Science	3
Physiology	4
Botany and Zoology	3
Elementary Science	5
Photography	1
Mathematics	3
Social Studies	5
Foreign Language	1
Industrial Arts	1
Home Economics	2
Driver Training	1
Health and Physical Education	6
No Minor Subjects	74
Two or More Minor Areas	5
Total Number of Teachers in this Category	112

TABLE CCXXIII

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA
OF TEACHING WAS IN GENERAL SCIENCE AND WHO HAD CERTAIN MINOR
AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	4
Chemistry	3
Biology	3
Physical Science	3
Elementary Science	15
Physiology	3
Physiography	1
Electricity	1
Mathematics	6
Social Studies	8
Driver Training	5
Auto Mechanics	1
Visual Education	1
Physical Education or Health	3
No Minor Subject	28
Two or More Minor Areas	9
Total Number of Teachers in this Category	77

Biology teachers particularly were one-subject teachers in the category of schools under consideration. Of 112 such teachers, 74 taught no other subject. General science teachers were more likely to be teaching other subjects, since only 28 of 77 were one-subject teachers. Most of these teachers who were teaching in subjects other than their major subject, were within the science area.

TABLE CCXXIV

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSICAL OR SENIOR SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Chemis try	1
Biology	1
General Science	1
Photography	1
Elementary Science	2
No Minor Subject	2
Two or More Minor Areas	1
Total Number of Teachers in this Category	7

TABLE CCXXV

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSIOLOGY, BOTANY, OR ZOOLOGY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	1
Biology	8
Eighth Grade Science	1
General Science	1
Social Studies	2
No Minor Subject	16
Total Number of Teachers in this Category	29

An appreciable number of teachers in the largest city high schools were teaching physical or senior science during a major portion of the day. It is somewhat interesting to observe that none of these teachers was teaching any subject other than science subjects.

The older sciences of zoology, botany, and physiology showed a sharp increase from the standpoing of number of teachers over any previous category of schools. Table CCXXV indicates that at the time of the study, 29 teachers in these schools were teaching one of these subjects either all or a major portion of their time. These three subjects are scarcely found in the county and exempted village schools.

TABLE CCXXVI

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSIOGRAPHY AND WHO HAD CERTAIN MINOR AREAS

Minor Areas of Teaching	Number of Teachers
Senior Science	1
Total Number of Teachers in this Category	1

TABLE CCXXVII

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF
TEACHING WAS IN ELECTRICITY AND RADIO

Teaching Situation	Number of Teachers
No Minor Areas	3
Total Number of Teachers in this Category	3

Tables CCXXVI and CCXXVII show that in the largest category of city schools, a few teachers were teaching science subjects during a major portion of the day which were not in the curricula of many of the schools treated in the preceding pages. One teacher was teaching physiography and three were teaching electricity and radio during either all or a major portion of the schoolday.

TABLE CCXXVIII.

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF
TEACHING WAS IN MATHEMATICS AND WHO HAD CERTAIN MINOR AREAS IN
SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	5
Chemistry	2
Biology	1
General Science	3
Botany, Zoology, Physiology	2
Aeronautics	1
Total Number of Teachers in this Category	14

Even in the largest city high schools, mathematics teachers were more likely to be called upon to teach classes of science than were any other group of teachers. While the dominance of physics in the mathematics-science teachers schedule is not nearly so great as it was in the smaller schools, the mathematics teacher even in this category is more likely to be teaching physics than any other science.

TABLE CCXXIX

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN SOCIAL STUDIES AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	1
General Science	1
Total Number of Teachers in this Category	2

TABLE CCXXX

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN ENGLISH AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Aeronautics	1
Total Number of Teachers in this Category	1

TABLE CCXXXI

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN INDUSTRIAL ARTS AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	1
Biology	1
General Science	2
Elementary Science	1
Two or More Science Areas	1
Total Number of Teachers in this Category	4

TABLE CCXXXII

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSICAL EDUCATION OR HEALTH AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	4
Physiology, Zoology, Botany	2
Elementary Science	1
Two or More Science Areas	1
Total Number of Teachers in this Category	6

TABLE CCXXXIII

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREAS
OF TEACHING WAS IN HOME ECONOMICS AND WHO HAD CERTAIN MINOR
AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Household Chemistry	2
Number of Teachers in this Category	2

TABLE CCXXXIV

TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WHOSE MAJOR AREA OF
TEACHING WAS IN AGRICULTURE AND WHO HAD CERTAIN MINOR AREAS IN
SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	1
Total Number of Teachers in this Category	1

Aside from mathematics teachers, few teachers of other subject areas in this category of schools were required to teach any science at all. Six physical education teachers were teaching some science, largely in the biological science area, and a scattered number of other teachers had small numbers of classes in the sciences. There were not enough of these teachers, see Table CCXXX - CCXXXIV to have significance other than the significance of the low numbers so found.

TABLE CCXXXV

DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS WITH REGARD TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR EXPENDITURE OF THEIR TEACHING TIME

Major Area of Teaching	Number of Teachers	Per cent of total
Physics	41	11.36
Chemistry	61	16.89
Biology	112	31.02
General Science	77	21.33
Senior Science	7	1.94
Physiology, Zoology, Botany	29	8.03
Physiography	1	0.28
Electricity and Radio	3	0.83
Mathematics	14	3.87
Social Studies	2	0.56
English	1	0.28
Industrial Arts	4	1.11
Physical Education and Health	6	1.66
Home Economics	2	0.56
Agriculture	1	0.28
Total Science	331	91.68
Total Non-Science	30	8.33
Totals	361	100.00

The full significance of Table CCXXXV can best be appreciated by comparing it with Table CVIII. Whereas in the earlier table, more than half of the teachers concerned were teaching science a minor portion of the day, in this classification only one-twelfth of the teachers were teaching science a minor portion of their time. Of these, almost half were teachers of mathematics.

TABLE CCXXXVI

DISTRIBUTION OF TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS
WITH REGARD TO THE NUMBER OF PREPARATION REQUIRED PER DAY

Number of Preparations	Number of Teachers	Per cent of total
1	112	31.03
2	171	47.37
3	63	17.45
4	15	4.15
Totals	361	100.00

Table CCXXXVI shows that only about one teacher in every five in the schools in this category had more than two preparations per day. Not only were these teachers more predominantly teaching science and science alone, to a great extent they were teachers of one and only one subject.

TABLE CCXXXVII

DISTRIBUTION OF TEACHERS IN OHIO'S LARGEST CITY HIGH SCHOOLS
WITH REGARD TO THE NUMBER OF CLASSES TAUGHT PER DAY

Number of Classes	Number of Teachers	Per cent of total
1	4	1.11
2	7	1.93
3	37	10.25
4	102	28.25
5	166	46.00
6	44	12.19
7	1	0.28
Totals	361	100.00

Little has been developed in the analysis of the number of classes taught by teachers in the largest high schools of the Ohio cities which could not have been predicted after having studied earlier results. In general, the same trends continued, but were less impressive insofar as changes were concerned between the next lower category and this one.

Summary of Ohio City Schools

The following tables summarize the conditions indicated in earlier tabulations of data concerning city schools of various enrollment categories. In the following tables, the data for the

various categories of schools have been summarized to obtain the picture in Ohio's cities as a whole concerning certain items having to do with major and minor areas of teaching.

TABLE CCXXXVIII

TEACHERS IN OHIO'S CITY SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Chemistry	15
Biology	5
General Science	14
Senior Science	10
Aeronautics	2
Physiology, Botany, Zoology	1
Elementary Science	1
Conservation	1
Photography	2
Personal Science	1
Radio	1
Electronics	1
Metallurgy	1
Descriptive Chemistry	2
Practical Science	1
Mathematics	19
Social Studies	2
English	2
Health and Physical Education	2
Driver Training	7
No Minor Subjects	11
Two or More Minor Areas	20
Total Number of Teachers in this Category	82

TABLE CCXXXIX

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF
TEACHING WAS IN CHEMISTRY AND WHO HAD CERTAIN
MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	39
Biology	11
General Science	28
Senior Science	10
Physiology, Botany, Zoology	2
Descriptive Chemistry	1
Aeronautics	1
Elementary Science	5
Photography	2
Industrial Chemistry	2
Mathematics	20
Social Studies	8
English	3
Agriculture	2
Commercial Subjects	1
Physical Education	3
Driver Training	2
Industrial Arts	1
No Minor Subjects	43
Two or More Minor Areas	36
Total Number of Teachers in this Category	142

Tables CCXXXVIII and CCXXXIX show that to a considerable extent teachers in Ohio's city schools who taught a major portion of their time in physics or chemistry were teaching in other areas

of science or in mathematics during the remaining portion of their day. There were many more teachers who might be classed as teachers of chemistry than those who might be called teachers of physics. Quite a large number of "minor" sciences such as photography and radio appeared in the teaching areas of these physics and chemistry teachers.

TABLE CCXL

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN BIOLOGY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	8
Chemistry	5
General Science	39
Senior Science	7
Physiology, Botany, Zoology	11
Practical Science	1
Eighth and Elementary Science	19
Photography	3
Museum Training	1
Nature Study	1
Mathematics	8
Social Studies	18
English	8
Foreign Language	3
Industrial Arts	2
Home Economics	3
Commercial Subjects	2
Agriculture	2
Health and Physical Education	17
Driver Training	4
No Minor Subjects	129
Two or More Minor Areas	24
Total Number of Teachers in this Category	267

Of 267 teachers in the city high schools whose major area of teaching was biology, almost half were teaching this subject alone. Few taught more than one subject in addition to biology. As in chemistry and physics, biology teachers in small numbers were teaching various "minor" sciences.

The following table, TABLE CCXLI shows that of the general science teachers (teachers having a major portion of their day in this field), over one-third were teaching this subject alone. Of those teaching other subjects, more were in elementary, seventh and eighth grade science than in any other area. Mathematics and the social studies were well represented also.

TABLE CCXLI

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN GENERAL SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	16
Chemistry	15
Biology	7
Senior Science	6
Physiology, Botany, Zoology	3
Elementary, Seventh and Eighth Grade Science	48
Electricity	3
Aeronautics	2
Physiography	1
Mathematics	30
Social Studies	27
English	1
Foreign Language	1
Commercial Subjects	2
Health and Physical Education	15
Driver Training	8
Home Economics	1
Industrial Arts	3
Auto Mechanics	1
Visual Education (taught as a class)	1
No Minor Subject	85
Two or More Minor Areas	41
Total Number of Teachers in this Category	228

TABLE CCXLII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSICAL OR SENIOR SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	2
Chemistry	2
Biology	1
General Science	2
Elementary Science	2
Photography	1
Social Studies	3
Physical Education and Health	1
No Minor Subjects	3
Two or More Minor Areas	3
Total Number of Teachers in this Category	12

Senior or physical science occupied the major portion of the teaching time of twelve teachers in the city high schools of the state. While this number is not large, it is somewhat significant, in view of the fact that these areas of science are of somewhat recent origin.

Table CCXLII indicates that these teachers, for the most part, were teaching in other science areas as well as in the senior or physical science.

TABLE CCXLIII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSIOLOGY, BOTANY, OR ZOOLOGY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Physics	1
Biology	8
General Science	1
Eighth Grade Science	1
Social Studies	3
No Minor Subjects	18
Total Number of Teachers in this Category	32

Table CCXLIII shows that while biology has forced the three subjects of botany, zoology, and physiology out of the curriculum of most of the smaller high schools in the state, they still are to be found in many of the cities. Of the 32 teachers in Ohio's city high schools who were devoting a major portion of their teaching time to one or the other of these three subjects, 18 were teaching no other subject. All except three of the rest were teaching only in science areas.

TABLE CCXLIV

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN PHYSIOGRAPHY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
Senior Science	1
Total Number of Teachers in this Category	1

TABLE CCXLV

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING
WAS IN SEVENTH AND EIGHTH GRADE SCIENCE AND WHO HAD CERTAIN MINOR
AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers
General Science	2
Senior Science	1
Total Number of Teachers in this Category	3

TABLE CCXLVI

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING
WAS IN ELECTRICITY AND RADIO

Conditions	Number of Teachers
No Minor Areas	3
Total Number of Teachers in this Category	3

Tables CCXLIV, CCXLV, and CCXLVI indicate that there were a few, but only a very few individuals teaching in Ohio's city high schools who devoted a major portion of their teaching time to subjects such as physiogrpahy and radio. No trends as such can be discovered in these tables -- they probably represent the efforts of strong-minded individuals who have seen or who have felt that there was a need for special work of the type not usually offered in secondary schools. It is unfortunate that time did not permit a study to be made of these "unusual" offerings in Ohio, to

determine the place that actually is being filled in the community by these special offerings.

TABLE CCXLVII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN MATHEMATICS AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	14
Chemistry	8
Biology	3
General Science	12
Physiology, Zoology, Botany	2
Senior or Physical Science	1
Radio	1
Aeronautics	1
Two or More Science Areas	2
Total Number of Teachers in this Category	41

TABLE CCXLVIII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN SOCIAL STUDIES AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	2
Chemistry	2
Biology	5
General Science	4
Senior Science	1
Two or More Science Areas	2
Total Number of Teachers in this Category	12

Among the teachers of academic subjects other than science in the city high schools, teachers of mathematics were more likely than any other to be teaching some science. While more mathematics teachers were teaching physics than any other science, the preponderance of physics was not nearly so great among city teachers of mathematics as it was among the county teachers of this subject. Mathematics teachers in the city schools who taught science taught in no other subject area of the curriculum except science and mathematics.

In few other areas of the curriculum were a significant number of individuals teaching science along with the other area. Exceptions were social science, see Table CCXLVIII, and Physical Education, see Table CCLII. In these two instances, the teachers concerned were much more likely to be teaching biological sciences than physical sciences. This same trend was observed throughout the county, city, and exempted village schools.

TABLE CCXLIX

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN ENGLISH AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	2
General Science	1
Senior Science	1
Aeronautics	1
Total Number of Teachers in this Category	5

TABLE CCL

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING
WAS IN FOREIGN LANGUAGE AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	1
Total Number of Teachers in this Category	1

TABLE CCLI

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING
WAS IN INDUSTRIAL ARTS OR VOCATIONAL AND WHO HAD CERTAIN MINOR
AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	2
Biology	2
General Science	4
Elementary Science	1
Two or More Science Areas	1
Total Number of Teachers in this Category	8

TABLE CCLII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING
WAS IN PHYSICAL EDUCATION AND HEALTH AND WHO HAD CERTAIN MINOR
AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	11
General Science	4
Physiology, Botany, Zoology	3
Elementary Science	1
Two or More Science Areas	1
Total Number of Teachers in this Category	18

TABLE CCLIII

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN HOME ECONOMICS AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	1
General Science	1
Household Chemistry	2
Total Number of Teachers in this Category	4

TABLE CCLIV

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN AGRICULTURE AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Biology	1
Total Number of Teachers in this Category	1

TABLE CCLV

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN MUSIC AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Physics	1
Total Number of Teachers in this Category	1

TABLE CCLVI

TEACHERS IN OHIO'S CITY HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN ART AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers
Chemistry	1
Biology	1
Advanced Science	1
Two or More Science Areas	1
Total Number of Teachers in this Category	1

Tables CCXLVIII - CCLVI indicate a finding which has been stated in earlier sections, namely that city teachers of science were very likely to be major teachers in the area. The tables listed show that very few teachers of science in the city schools were teachers of English, foreign language, commercial subjects, home economics, industrial arts, etc. To a much greater extent than in the smaller schools the city teachers were subject specialists. These findings are borne out further in Table CCLVII which follows:

TABLE CCLVII

DISTRIBUTION OF OHIO'S CITY HIGH SCHOOL SCIENCE TEACHERS WITH
RESPECT TO THE AREA OF TEACHING WHICH REQUIRED THE MAJOR
EXPENDITURE OF THEIR TEACHING TIME

Major Area of Teaching	Number of Teachers	Per cent of total
Physics	82	9.51
Chemistry	142	16.47
Biology	267	30.47
General Science	228	26.45
Senior Science	12	1.39
Seventh and Eight Grade Science	3	0.35
Physiology, Botany, Zoology	32	3.71
Physiography	1	0.12
Electricity and Radio	3	0.35
Mathematics	41	4.75
Social Studies	12	1.39
English	5	0.58
Foreign Language	1	0.12
Industrial Arts	8	0.92
Home Economics	4	0.47
Physical Education and Health	18	2.09
Agriculture	1	0.12
Art	1	0.12
Music	1	0.12
Total Science	760	89.32
Total Non-Science	102	10.68
Total Number of Teachers in this Category	862	100.00

TABLE CCLVIII

DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S CITY SCHOOLS WITH
RESPECT TO THE NUMBER OF PREPARATIONS REQUIRED PER DAY

Number of Preparations	Number of Teachers	Per cent of total
1	244	28.30
2	377	43.73
3	191	22.15
4	48	5.57
5	1	0.12
6	0	0.00
7	1	0.12
8	0	0.00
Totals	862	100.00

Table CCLVIII summarizes the findings with regard to number of preparations per day. Taken as a whole, the city teachers had fewer preparations per day than did the county teachers. More than seven of every ten city teachers had either one or two preparations per day. Only two city teachers had as many as five preparations per day, with less than six per cent having four or more separate preparations. A comparison with conditions in the smallest county schools is somewhat enlightening. In this group of schools, sixty per cent of the teachers had five or more preparations per day.

TABLE CCLIX

DISTRIBUTION OF SCIENCE TEACHERS IN OHIO'S CITY HIGH SCHOOLS WITH
RESPECT TO THE NUMBER OF CLASSES TAUGHT PER DAY

Number of Classes	Number of Teachers	Per cent of total
1	7	0.81
2	18	2.08
3	68	7.89
4	259	30.05
5	370	42.92
6	127	14.73
7	11	1.28
8	2	0.24
Totals	862	100.00

With respect to the number of classes taught per day, there was no significant difference from the smallest schools to the largest. In all categories the median number was five per day. The data for Ohio's city schools have been shown in Table CCLIX.

TABLE CCLX

NUMBER OF TIMES THE FOUR MAJOR SCIENCES WERE MENTIONED IN THE
TEACHING AREAS OF THOSE TEACHING SCIENCE A MAJOR PORTION OF THEIR
TIME AND A MINOR PORTION OF THEIR TIME IN THE OHIO CITY HIGH
SCHOOLS

Subjects	Occurrence Among Science Teaching Majors	Occurrence Among Non-Science Teaching Majors
Physics	148	19
Chemistry	179	11
Biology	304	22
General Science	314	26
Totals*	955	78

* Totals are comparative only and do not indicate the total number of teachers. Teachers may have been (and were) oftentimes counted twice.

The extent to which science was being taught in city schools by teachers who were spending a major portion of their teaching time in the science field as opposed to those spending only a minor portion therein has been shown in Table CCLX. In the cities as a group, only about seven and a half per cent of the teachers who were teaching any science at all were minor teachers in the field.

Summary of All Ohio Schools

Tables have been prepared which summarize the conditions in all Ohio high schools with regard to teaching combinations of the teachers in these schools. In some instances reference has been made to tables in other portions of this chapter rather than merely repeating a table here. For example, all data relative to teachers who taught combinations of sciences in about equal fashion are to be found in Table CXLV, since this situation prevailed only in the county schools. Table CXLV and similar tables have not been repeated because there was no particular point in repeating the same tabulations.

Likewise, Table CLVII, relating to teachers with major area in commercial; Table CCXLIII relating to teachers with major areas in physiology, botany, or zoology; Table CCXLIV relating to teachers with major areas in Physiography; Table CCXLVI which relates to teachers having major areas in Electricity and Radio;

Table CCLV which relates to teachers having major area in Music; and Table CCLVI relating to teachers having a major area in Art have not been included since they are found only in one category and do not need summarizing.

While the tables as summarized give pertinent information in summation, perhaps their greatest usefulness is to be found in the comparisons offered as among the three types of high schools to be found in the State of Ohio. For this reason, the cities, exempted villages, and counties have been listed separately. The tables follow:

TABLE CCLXI

TEACHERS IN OHIO'S HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS PHYSICS AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers			
	County	Ex. Village	City	Totals
Chemistry	0	5	15	20
Biology	0	0	5	5
General Science	0	4	14	18
Senior Science	1	2	10	13
Seventh and Eighth Grade Science	13	3	1	17
Physiology, Botany, Zoology	0	0	1	1
Photography	0	0	2	2
Electricity, etc.	1	0	0	1
Radio, Electronics	0	0	2	2
Practical Science	0	0	1	1
Aeronautics	0	1	2	3
Conservation	0	0	1	1
Personal Science	0	0	1	1
Metallurgy	0	0	1	1
Descriptive Chemistry	0	0	2	2
Agriculture	0	1	0	1
Mathematics	9	3	19	31
Social Studies	11	1	2	14
English	3	0	2	5
Foreign Language	2	0	0	2
Industrial Arts	6	0	0	6
Commercial Subjects	2	1	0	3
Home Economics	1	0	0	1
Physical Education and Health	4	0	2	6
Driving	0	1	7	8
No Minor Subject	20	7	11	38
Two or More Minors	17	7	20	44
Total	48	15	82	145

In the state as a whole, the physics-chemistry combination and the physics-mathematics combination appeared to be strong among those individuals who spent a major portion of their time in the teaching of physics. In the county schools, physics teachers were much more likely to be teaching in unrelated (non-science) fields than they were in the larger schools.

TABLE CCLXII

TEACHERS IN OHIO'S HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS CHEMISTRY AND WHO HAD MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers			
	County	Ex. Village	City	Total
Physics	5	8	39	52
Biology	0	1	11	12
General Science	1	5	28	34
Senior Science	0	2	10	12
Seventh and Eight Grade Science	5	2	5	12
Physiology, Botany, Zoology	0	0	2	2
Aeronautics	0	0	1	1
Photography	0	0	2	2
Descriptive Chemistry	0	0	1	1
Industrial Chemistry	0	0	2	2
Mathematics	8	4	20	32
Social Studies	5	2	8	15
English	6	0	3	9
Industrial Arts	2	0	1	3
Commercial Subject	0	0	1	1
Agriculture	0	0	2	2
Driving	0	1	2	3
Physical Education and Health	2	0	3	5
Music	1	0	0	1
No Minor Subject	16	5	43	64
Two or More Minor Areas	10	8	36	54
Totals	38	22	142	202

The findings revealed for physics teachers in Table CCLXI have been repeated for chemistry teachers to a very great extent in Table CCLXII. The physics-chemistry and chemistry-mathematics combination are both quite prominent among these teachers who spent a major portion of their teaching day in chemistry.

TABLE CCLXIII

TEACHERS IN OHIO'S HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN BIOLOGY AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers			
	County	Ex. Village	City	Total
Physics	2	9	8	19
Chemistry	1	7	5	13
General Science	12	14	39	65
Senior Science	4	0	7	11
Seventh and Eighth Grade Sc.	19	6	19	44
Conservation	1	0	0	1
Physiology, Botany, Zoology	0	1	11	12
Aeronautics	0	1	0	1
Photography	0	0	3	3
Practical Science	0	0	1	1
Museum Training	0	0	1	1
Nature Study	0	0	1	1
Mathematics	27	7	8	42
Social Studies	30	10	18	58
English	11	2	8	21
Foreign Language	4	1	3	8
Industrial Arts	6	4	2	12
Commercial Subject	7	0	2	9
Home Economics	2	0	3	5
Agriculture	7	0	2	9
Driver Training	2	3	4	9
Physical Education and Health	31	7	17	55
Music	2	0	0	2
Art	3	0	0	3
No Minor Subject	10	4	129	142
Two or More Minors	50	21	24	95
Totals	101	51	267	419

In Ohio's schools, teachers whose major area of teaching was in biology were likely to be found teaching almost any other subject in the curriculum. While many of them were teaching general science, many also were in social studies, seventh and eighth grade science, mathematics, and in numerous other areas.

TABLE CCLXIV

TEACHERS IN OHIO'S SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN GENERAL SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers			
	County	Ex. Village	City	Total
Physics	18	18	16	52
Chemistry	17	17	15	49
Biology	18	15	7	40
Senior Science	6	3	6	15
Seventh and Eighth Grade Science	51	13	48	112
Physiology, Botany, Zoology	1	0	3	4
Conservation	1	0	0	1
Photography	1	0	0	1
Aeronautics	0	0	2	2
Practical Science	1	0	0	1
Electricity	0	0	3	3
Physiography	0	0	1	1
Visual Education	0	0	1	1
Auto Mechanics	0	0	1	1
Mathematics	32	13	30	75
Social Studies	40	8	27	75
English	14	0	1	15
Foreign Language	2	0	1	3
Music	2	0	0	2
Commercial Subjects	3	1	2	6
Industrial Arts	11	2	3	16
Home Economics	3	0	1	4
Agriculture	4	1	0	5
Physical Ed. and Health	39	6	15	60
Driver Training	4	0	8	12
No Minor Areas	8	4	85	97
Two or More Minor Areas	92	33	41	166
Totals	142	57	228	427

Table CCLXIV has been designed to indicate the teaching fields of those individuals in Ohio's schools who teach general science as a major area. As with biology teachers, general science teachers were likely to be found in almost any other subject area in the curriculum. As a subject, general science seems to have been "farmed out" to teachers of other areas more than most other subjects in the science curriculum.

TABLE CCLXV

TEACHERS IN OHIO'S HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN SENIOR SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers		
	Exempted Village	City	Totals
Physics	0	2	2
Chemistry	0	2	2
Biology	0	1	1
General Science	1	2	3
Seventh and Eighth Grade Science	1	2	3
Photography	0	1	1
Mathematics	1	0	1
Social Studies	0	3	3
Physical Education and Health	1	1	2
No Minor Areas	0	3	3
Two or More Minor Areas	1	3	4
Totals	3	12	15

The comparative place of senior science in the schools of Ohio may be estimated (but not arrived at accurately) by reference to Table CCLXV. It has made its impress in some schools in all

categories in the state, but in no case except in a few exempted villages and a few cities was enough senior science being offered to require the major time service of a teacher.

TABLE CCLXVI

TEACHERS IN OHIO'S HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS IN SEVENTH AND EIGHTH GRADE SCIENCE AND WHO HAD CERTAIN MINOR AREAS OF TEACHING

Minor Areas of Teaching	Number of Teachers		
	County	City	Totals
General Science	0	2	2
Senior Science	0	1	1
Physiography	1	0	1
Agriculture	1	0	1
Social Studies	1	0	1
Two or More Minors	1	0	1
Totals	1	3	4

The number of teachers who spent a major portion of their time in the teaching of seventh and eighth grade science, and who also taught other areas of science was so small as to be of little significance in this study.

TABLE CCLXVII

TEACHERS IN OHIO'S HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS
IN MATHEMATICS AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers			
	County	Exempted Village	City	Totals
Physics	153	22	14	189
Chemistry	43	10	8	61
Biology	41	2	3	46
General Science	107	7	12	126
Senior Science	7	1	1	9
Seventh and Eighth Grade Science	33	4	0	37
Physiology, Botany, Zoology	0	0	2	2
Conservation	1	0	0	1
Aeronautics	1	0	1	2
Radio	0	0	1	1
Two or More Sciences	97	12	2	111
Totals	270	32	41	343

Teachers of mathematics, more than any other non-science teachers, were likely to be teaching one or more classes of science. In the state as a whole, these teachers were more likely to be teaching physics than any other science, with general science next. These conditions were largely the result of the predominancy of physics and general science in the teaching day's of the rural mathematics teachers. Even at city level, however, when mathematics teachers taught any science at all it was likely to be physics or general science.

TABLE CCLXVIII

TEACHERS IN OHIO'S HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS
IN SOCIAL STUDIES AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers			
	County	Ex. Village	City	Totals
Physics	13	0	2	15
Chemistry	4	1	2	7
Biology	64	5	5	74
General Science	63	1	4	68
Senior Science	3	0	1	4
Seventh and Eighth Grade Sciences	28	0	0	28
Physiology, Botany, Zoology	4	0	0	4
Conservation	2	0	0	2
Two or More Sciences	38	0	2	40
Totals	139	7	12	158

State-wide, as shown in Table CCLXVIII, teachers of social studies lagged only behind mathematics teachers in their science teaching. These results tallied closely with the conditions in Nebraska discovered by Engel.² On the other hand, almost all of these teachers were from the county schools. Few social studies teachers in the exempted villages and cities were teaching science. When social studies teachers taught science, they were very likely to teach biological or general science,

2

Marion Engel, op. cit.

TABLE CCLXIX

TEACHERS IN OHIO'S HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS
IN ENGLISH AND WHO HAVE CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers			
	County	Ex. Village	City	Total
Physics	8	2	0	10
Chemistry	4	1	0	5
Biology	29	2	2	33
General Science	9	0	1	10
Senior Science	0	0	0	6
Seventh and Eighth Grade Science	6	0	0	6
Physiology, Botany, Zoology	2	0	0	2
Aeronautics	0	0	1	1
Two or More Sciences	12	2	0	14
Totals	45	3	5	53

Aside from teachers in the county schools, only a statistically insignificant number of English teachers were teaching science in Ohio's schools. The same statement holds true for teachers of foreign languages, see Table CCLXX.

TABLE CCLXX

TEACHERS IN OHIO'S HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS
IN FOREIGN LANGUAGE AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers			
	County	Ex. Village	City	Total
Physics	2	0	0	2
Chemistry	2	0	0	2
Biology	12	1	1	14
General Science	9	0	0	9
Physiology, Botany, Zoology	2	0	0	2
Two or More Minor Science Areas	3	0	0	3
Totals	23	1	1	25

TABLE CCLXXI

TEACHERS IN OHIO'S HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS
IN INDUSTRIAL ARTS AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Teaching	Number of Teachers			
	County	Ex. Village	City	Total
Physics	12	0	2	14
Chemistry	4	0	0	4
Biology	18	1	2	21
General Science	24	0	4	28
Senior Science	2	0	0	2
Seventh and Eighth Grade Sc.	13	0	1	14
Aeronautics	1	0	0	1
Two or More Sciences	17	0	1	18
Totals	53	1	8	62

TABLE CCLXXII

TEACHERS IN OHIO'S HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS
IN HOME ECONOMICS AND WHO HAD CERTAIN MINOR AREAS IN SCIENCE

Minor Areas of Science	Number of Teachers			
	County	Ex. Village	City	Total
Chemistry	7	0	0	7
Biology	40	0	1	41
General Science	23	1	1	25
Seventh and Eighth Grade Sc.	11	0	0	11
Household Chemistry	0	0	2	2
Two or More Minor Sciences	15	0	0	15
Totals	64	1	4	69

In the county schools, industrial arts teachers and home economics teachers were quite likely to be teaching sciences, particularly biology and general science. On the other hand, their numbers, see Tables CCLXXI and CCLXXII, in exempted villages and cities were quite small.

TABLE CCLXXIII

TEACHERS IN OHIO'S HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING
WAS IN PHYSICAL EDUCATION AND HEALTH AND WHO HAD CERTAIN MINOR
AREAS IN SCIENCE

Minor Areas of Science	Number of Teachers			
	County	Ex. Village	City	Total
Physics	5	0	0	5
Chemistry	2	2	0	4
Biology	34	8	11	53
General Science	23	6	4	33
Senior Science	2	0	0	2
Seventh and Eighth Grade Science	20	0	1	21
Physiology	1	0	3	4
Two or More Sciences	26	2	1	29
Totals	58	13	18	89

Teachers of physical education (including coaches) are a factor in all categories of schools when science teaching is being considered. Of the 89 individuals teaching in both areas, quite a number, proportionately were found in all three classes of schools.

TABLE CCLXXIV

TEACHERS IN OHIO'S HIGH SCHOOLS WHOSE MAJOR AREA OF TEACHING WAS
IN AGRICULTURE AND WHO HAD CERTAIN AREAS OF TEACHING IN SCIENCE

Minor Areas of Science	Number of Teachers		
	County	City	Totals
Physics	1	0	1
Biology	2	1	3
General Science	1	0	1
Totals	4	1	5

The number of teachers of agriculture who also taught science was too small to be significant.

In addition to the teachers listed in the preceding tables, there was one teacher in the county schools who devoted the major portion of his time to Driver Training and who had minor areas in Physiology and in English. One exempted village teacher taught Radio and Electricity with no minors.

In the preceding tables, together with those referenced earlier in this section, data concerning 2516 teachers of science have been included. These data include items relating to all teachers who taught any science of any kind in the schools of Ohio. This figure does not quite tally with the figure of 2509 given in the information concerned with teacher training. That information was, however, not quite complete, and it was necessary to omit a few teachers from reckoning because of the fact that no data were provided concerning their training, whereas data were available concerning the subjects taught.

Subjects Offered in Various High Schools

Breadth of offering is probably an important factor in the total effectiveness of a science program within a high school. In order to determine in some fashion the breadth of curriculum as concerned number of science offerings in the various high schools, the following data have been determined and presented.

TABLE CCLXXV

SCIENCE CURRICULAR OFFERINGS IN OHIO'S SMALLEST COUNTY HIGH
SCHOOLS (1-25 PUPILS PER GRADE) 1950-51

Curricular Offerings	Number of high schools
General Science only	20
Biology only	11
Physics only	2
Chemistry only	1
Biology and Physics	24
General Science and Physics	62
General Science and Chemistry	19
General Science and Biology	33
Biology and Chemistry	14
General Science and Senior Science	8
Biology and Senior Science	2
General Science and Botany	1
General Science and Physiology	1
General Science, Biology, and Chemistry	42
General Science, Biology, and Physics	115*
General Science, Biology, and Senior Science	4
General Science, Physics, and Senior Science	2
General Science, Chemistry, and Senior Science	1
General Science, Biology, and Conservation	1
General Science, Chemistry, and Conservation	1
General Science, Biology, Physics, and Chemistry	2
General Science, Chemistry, Biology, and Aeronautics	1
General Science, Biology, Chemistry, and Physiology	1
General Science, Biology, Physics, and Senior Science	2
General Science, Biology, Physics, and Conservation	3
Totals	372

*

This figure compared with the one above it illustrates to a certain extent the practice of alternating physics and chemistry, particularly in the smaller high schools. Figures taken a year earlier or a year later would show a different ratio as between physics and chemistry.

Paucity of science offerings in the smallest category of county schools was indicated by the fact that 34 schools, or almost ten per cent, offered one science only. In some cases, one science may have been alternated with another science, but in other cases there was evidence that no alternation occurred and that the single science was the total offering of the school, science-wise. In this same classification of schools, 164 schools offered two sciences only, while just two more offered three sciences. There is some significance to the fact that more schools in this category offered the combination of general science, biology, and physics than offered any other combination. Chemistry has been excluded in many of these schools because of a lack of any adequate facilities for teaching the subject. Only nine of these schools offered four sciences, and in only two of these was it the standard four sciences, general science, biology, physics, and chemistry.

Conditions in the next larger category of county schools, see Table CCLXXVI, show a very great decrease in number of schools offering one science only. There are quite a number, however, which offered only two sciences. Over sixteen per cent of these schools were in that situation. Again, the modal curricular group includes general science, biology, and physics. There was a sharp rise in the number of schools offering four sciences, and among these a very great predominance for the standard four. One school

in this group offered five sciences, including physiology as the fifth.

TABLE CCLXXVI

SCIENCE OFFERINGS IN OHIO'S MEDIUM-SIZED COUNTY HIGH SCHOOLS
(26-50 PUPILS PER GRADE) 1950 - 51

Curricular Offerings	Number of high schools
General Science (only)	4
General Science and Biology	22
General Science and Chemistry	5
General Science and Physics	20
Biology and Physics	7
General Science, Biology, and Chemistry	69*
General Science, Biology, and Physics	142
General Science, Chemistry, and Physics	1
Biology, Physics, Mechanics	1
Biology, Chemistry, Senior Science	1
General Science, Biology, Senior Science	5
Biology, Chemistry, and Physics	5
General Science, Biology, Chemistry, Physics	32
General Science, Biology, Chemistry, and Senior Sc.	2
General Science, Biology, Physics, and Senior Sc.	5
General Science, Biology, Chemistry, and Physiology	1
General Science, Biology, Physics, and Coal Mining Sc.	1
General Science, Biology, Chemistry, and Coal Mining Sc.	2
Biology, Physics, Senior Science, and Advanced Biology	1
General Science, Biology, Physics, and Aeronautics	1
General Science, Biology, Physics, and Physiology	1
General Science, Biology, Chemistry, Physics, and Physiology	1
Totals	329

*

See note on preceding table.

TABLE CCLXXVII

SCIENCE OFFERINGS IN OHIO'S LARGEST COUNTY HIGH SCHOOLS (Over
50 PUPILS PER GRADE) 1950-51

Curricular Offerings	Number of high schools
General Science and Physics	1
General Science and Chemistry	1
Biology and Physics	1
General Science, Biology, and Chemistry	15
General Science, Biology, and Physics	28
Biology, Chemistry, and Physics	2
General Science, Biology, Chemistry, and Physics	38
General Science, Biology, Physics, and Aeronautics	1
General Science, Biology, Physics, and Senior Science	5
General Science, Biology, Chemistry, and Physiology	2
General Science, Biology, Physics, and Electrical Engineering	1
General Science, Biology, Physics, and Physiology	1
General Science, Biology, Chemistry, and Practical Sc.	1
General Science, Biology, Chemistry, and Mechanics	1
General Science, Biology, Chemistry, and Conservation	2
General Science, Biology, Chemistry, Physics, and Senior Science	4
General Science, Biology, Chemistry, Physics, and Aeronautics	3
General Science, Biology, Chemistry, Physics, and Coal Mining Science	1
General Science, Biology, Chemistry, Physics, and Photography	2
General Science, Biology, Chemistry, Physics, and Physiology	2
General Science, Biology, Chemistry, Physics, and Physiography	1
General Science, Biology, Chemistry, Physics, and Conservation	1
Totals	114

In Ohio's largest county high schools, see Table CCLXXVII, there were only three which offered but two subjects in science. Quite a number offered three subjects, but there were more which offered four. The modal subject offering was the standard four. Fourteen of these schools offered five subjects in their science

course of study.

TABLE CCLXXVIII
SCIENCE OFFERINGS IN OHIO'S EXEMPTED VILLAGE SCHOOLS,
1950-51

Curricular Offerings	Number of Schools
General Science and Biology	1
General Science, Physics, and Senior Science	1
Biology, Physics, and Senior Science	1
General Science, Biology, and Chemistry	9
General Science, Chemistry, and Physics	2
General Science, Biology, and Physics	8
Biology, Physics, and Chemistry	1
General Science, Biology, Chemistry, and Physics	50
General Science, Biology, Physics, and Senior Sc.	4
General Science, Biology, Chemistry, and Senior Sc.	2
General Science, Biology, Chemistry, Physics, and Senior Science	4
General Science, Biology, Chemistry, Physics, and Physiology	1
Totals	84

As in other matters, there was less range among the exempted village schools in the matter of subject offerings than was true among the other groups of schools. Only one school offered but two science subjects, only five offered more than four. More than half of the exempted village schools offered the standard four sciences. Senior science was somewhat of a factor in the exempted village schools, but in very few cases did it take the place of physics as a curricular offering. Physiology was offered in only one school, and botany and zoology not at all.

TABLE CCLXXIX

SCIENCE OFFERINGS IN OHIO'S CITY HIGH SCHOOLS (ENROLLMENT 1-100
PUPILS PER GRADE), 1950-51

Curricular Offerings	Number of Schools
General Science, Biology, and Chemistry	3
General Science, Chemistry, and Physics	1
Biology, Chemistry, and Physics	1
General Science, Biology, Chemistry, Physics	14
General Science, Biology, Chemistry, Physics, and Senior Science	3
General Science, Biology, Chemistry, Physics, and Physiology	1
Totals	23

Science offerings in Ohio's smallest group of city high school resembled somewhat the offerings in the exempted villages. None offered less than three sciences, while four offered five sciences. Senior science and physiology were the additional subjects offered in these latter cases. Again, senior science seems not to have replaced physics in the curriculum, but to have been added as an additional subject.

TABLE CCLXXX

SCIENCE OFFERINGS IN OHIO'S CITY HIGH SCHOOLS (ENROLLMENT 101-
200 PUPILS PER GRADE), 1950-51

Curricular Offerings	Number of Schools
Biology, Chemistry, Senior Science	1
General Science, Biology, and Chemistry	1
General Science, Biology, and Physics	1
Biology, Chemistry, and Physics	7
General Science, Biology, Chemistry, and Physics	25
General Science, Biology, Chemistry, Physics, and Senior Science	12
General Science, Biology, Chemistry, Physics, Senior Science, and Physiology	2
General Science, Biology, Chemistry, Physics, and one Minor Science	7
Totals	56

TABLE CCLXXXI

SCIENCE OFFERINGS IN OHIO'S CITY HIGH SCHOOLS (ENROLLMENTS 201-300 PUPILS PER GRADE), 1950-51

Curricular Offerings	Number of Schools
Biology, Chemistry, and Physics	7
General Science, Biology, Chemistry, and Physics	17
General Science, Biology, Chemistry, Physics, and Senior Science	5
General Science, Biology, Chemistry, Physics, and Physiology	1
General Science, Biology, Chemistry, Physics, Senior Science, and Physiology	2
General Science, Biology, Chemistry, Physics, Senior Science and two minor sciences	3
Totals	35

In Ohio's two middle-sized categories of city high schools, see Tables CCLXXX and CCLXXXI, the science offerings continued to be enlarged somewhat with increasing pupil population. Three schools in the larger of these two groups had as many as seven science offerings. In these two tables, when "minor science" is mentioned, one of the uncommon sciences such as radio, electronics, botany, etc. have been indicated.

TABLE CCLXXXII

SCIENCE OFFERINGS IN OHIO'S CITY HIGH SCHOOLS (ENROLLMENT OVER
300 PUPILS PER GRADE) 1950-51

Curricular Offerings	Number of Schools
Biology and Senior Science	1
Biology, Chemistry, and Physics	3
General Science, Biology, Chemistry, and Physics	4
Chemistry, Physics, and three minor sciences	1
General Science, Biology, Chemistry, Physics, and Senior Science	10
General Science, Biology, Chemistry, Physics, and Physiology	2
General Science, Biology, Chemistry, Physics, Senior Science, and Physiology	5
General Science, Biology, Chemistry, Physics, and two minor sciences	11
General Science, Biology, Chemistry, Physics, and three or more minor sciences	12
Totals	49

Large number of pupils alone is not a guarantee of a broad science curriculum. Table CCLXXXII shows that there were four of the high schools in the largest category which had three or less science offerings. On the other hand, the greater number of schools in this classification did have rather broad offerings. Only one school in this category did not offer chemistry, only one did not offer physics. All of them offered biology.

TABLE CCLXXXIII

SCIENCE SUBJECTS (ASIDE FROM THE STANDARD FOUR*) OFFERED IN OHIO'S
HIGH SCHOOLS, 1950-51

Name of Subjects	Number of Schools
Advanced Biology	1
Advanced Chemistry	1
Advanced Science	3
Aeronautics	16
Aero Physics	1
Applied Science	1
Botany (with its variants)	14
Coal Mining Science	4
College Biology	1
Conservation	7
Descriptive Chemistry	3
Descriptive Physics	1
Electrical Engineering	1
Electricity	2
Electronics	3
Eleventh Grade Science	1
Home Economics Chemistry	1
Household Chemistry	2
Industrial Chemistry	2
Industrial Science	1
Level Science	1
Life Science	1
Mechanics	2
Metallurgy	1
Museum Training	1
Nature Study	1
Organic Chemistry	1
Personal Science	1
Photography (as a science)	10
Physiography	3
Physiology	35
Practical Biology	1
Practical Science	4
Radio (and its variants)	6
Radio Code	1
Senior Science	91
Shop Science	1
Tenth Grade Science	3
Zoology	7

* General Science, Biology, Chemistry, and Physics.

In view of the fact that many of the subjects listed in the preceding table are variants of regular science offerings, they have been treated as regular offerings throughout this study with the exception that they have been specially treated in this table.

Advanced biology, college biology, etc. all have been treated as biology in determining data concerning teacher load in preparations. The various advanced sciences have been classified chiefly under the term senior science in the earlier tabular material of this chapter. These steps were taken in the interest of saving space, the investigator believing that calling them out in this table would give sufficient note to the fact that these science variants existed.

There was little uniformity concerning the placement of the "stray" sciences with a few notable exceptions. Apparently in at least two localities in the state some thought has been given to the special needs of the student. Much of the conservation teaching, for example, has been listed (as a separate subject) in the rural schools of Trumbull county, an excellent farming area which probably is anxious that its youth should be conservation-minded. Special needs also receive curricular attention in Jefferson county where coal mining science was found in the curriculums of four of the schools in the heart of the bituminous belt. While

these two subjects seem to indicate some local focus of attention on one of the probable factors of effectiveness, there seemed to be little over-all evidence tending to show that special needs had been recognized by the erection of new science courses. Other courses seemed likely to be in their position either because of local desire for changing the curriculum (or for retaining present courses), or perhaps in many instances, the desire of a strong individual in the science department to institute a particular course (such as Aero Physics).

An example of the first kind of arrangement is the prevalence of the older sciences (physiology, zoology, botany) in the Cincinnati area, and the prevalence of senior science and its variants (consumer science, advanced science, physical science) in the Cleveland and surrounding area. These efforts in the north-eastern area of Ohio probably stem back to the pioneer work of Bush and his collaborators in the Cleveland system -- which had less apparent impact the further from Cleveland a given school was located.

Unfortunately nothing may be obtained in a study of this type concerning adaptations which have been made within standard courses to provide for special needs or for the general needs of youth. Data presented in this chapter do not indicate that much had been done in the way of erection of new courses to meet either general needs or specialized needs of our young people.

Summary

The general findings in this chapter have been summarized as follows:

1. Almost one-third of the local executives in Ohio's least populous group of county high schools were teaching one or more classes of science in addition to their administrative duties. Generally speaking, this percentage dwindled rapidly with increasing pupil population. In no case was any city high school principal teaching any science class.

2. Almost half of the schools in the smallest category of county high schools had one science teacher only. This figure dwindled with increasing pupil population so that in the largest category of county high schools, only about one high school in eight depended for its science instruction on one individual alone.

3. In the smallest category of county high schools, of 173 teachers who taught a mixed schedule of science during a major portion of the day, there were only fourteen who were not also teaching in at least one subject area other than secondary-school science. Of the 173, there were 113 individuals who were teaching in two or more areas in addition to their combination science area.

In the next larger group of county high schools, teachers were much less likely to be teaching a variety of subjects than in the smallest category in terms of pupil population. In the largest county high schools, specialization was noted to even a greater extent, but there were still teachers who needed to be considered as "combination science majors" so far as their teaching day was concerned. There was no way of distinguishing a major area in their teaching schedule.

In the exempted villages and in the cities, it was possible, in almost all cases, to distinguish one area of teaching or another which could be classified as a major area in terms of amount of teacher time spent daily in that area.

4. Of 23 teachers in the smallest category of schools in Ohio, whose major area of teaching was in physics, ten taught two or more different subjects in addition to physics. The same conditions prevailed to an even greater extent among those teachers whose major area of teaching were in chemistry, biology, and general science.

5. In the smallest county schools, physics and general science were more likely to be taught by a teacher whose major area of teaching was in mathematics than by one whose major area was in physics or in general science respectively. These mathematics teachers were more likely to teach one of these two sciences than they were to teach biology or chemistry.

6. Teachers in all categories of Ohio's schools whose major area of teaching was in the social studies and who also taught some science were more likely to teach general science or biology than to teach chemistry or physics.

7. Teachers in Ohio's schools whose major area was home economics were not very likely to be teaching science. When they did (as they often did in the smallest categories of schools) they were more likely to teach biology than any other science. They were very unlikely to teach physics.

8. Teachers in Ohio's schools whose major area of teaching was in English and foreign language were not very likely to be teaching science. When they did, they were much more likely to be teaching biology than any other science. They also were somewhat likely to teach general science. They were most unlikely to teach chemistry or physics.

9. Individuals who taught health and physical education a major portion of their time were quite likely to be general science or biology teachers in the county schools. In the city schools they were less likely to be teaching science, but when they did they were very likely to be teaching biological sciences or general science.

10. Commercial teachers were much less likely to be teaching sciences than were most other categories of teachers. When they did, they were more likely to teach general science or biology than other subjects.

11. Teachers whose major area of teaching was in industrial arts were quite likely to be teaching any of the usual sciences in the smaller schools. In the larger schools they were quite unlikely to be teaching any science at all. Agriculture teachers were not very likely to teach science.

12. In the smallest category of county schools from a standpoint of pupil population, there were more individuals teaching some science who were not teaching science a major portion of their time than there were individuals who were teaching it a major portion of their time. This condition indicates a strong possibility that in this category, more pupils were receiving science instruction from teachers who looked upon science as a field of lesser interest than from those who considered science a major interest.

This condition improved rapidly with increase in population of the schools, so that in the largest city high schools, almost all individuals teaching science were engaged in it during a major portion of their school day, and in most cases for the entire school day.

13. The fact that teachers of non-science and non-science related subjects were much more likely, in general, to be teaching biology and general science in the schools of Ohio than they were to be teaching chemistry and physics points to the very great danger that in many more cases have these subjects been taught by individuals who have little knowledge about them, little interest in them, or both. It points to the possibility that, particularly in the smaller schools, these two areas of work may be mistaught to a very considerable extent, due to the factor mentioned.

14. In the smallest schools, almost one-fourth of the individuals teaching science subjects had six, seven, or eight separate preparations per day. Approximately sixty per cent had five or more separate preparations per day. This situation became progressively better until in the largest category of city teachers, only about one teacher in five had more than two preparations, and approximately one-third of the teachers had only one preparation.

15. In all categories of schools in Ohio, the median number of classes taught per day was five. Teachers in other subject areas should keep in mind that within this median of five are found many double-period sections and many seven-period-per-week sections, so that the figure of five classes per day is somewhat misleading.

16. Teachers in the county schools who were listed as teaching chemistry or physics and no other subject were very likely to be executive heads of the schools. When such listing was made in the exempted village schools, the teacher was likely to be the principal of the school.

17. In the county schools as a group, teachers whose major area of teaching was in biology were likely to be teaching almost any other subject in the curriculum, but a greater number were teaching social studies, mathematics, and physical education than any other non-science subjects.

18. Throughout, in all categories, there seem to be many biology teachers teaching social studies, many social studies teachers teaching biology. Similarly, there seem to be many physics teachers teaching mathematics, more mathematics teachers teaching physics.

19. General science teachers in the county schools were likely to be teaching any of the other sciences, but were especially likely to be teaching seventh and eighth grade science. They also were likely to be teaching almost any other subject in the curriculum, but especially social studies, physical education, mathematics, English, and industrial arts.

20. Exempted village teachers who taught mathematics a major portion of their time were very likely to be teaching either chemistry or physics or both.

21. With increase in school population, first a trend developed which led away from the teaching of a combination of sciences plus other subjects toward a combination of sciences alone with one subject being in predominant position, and finally in the larger schools to a situation in which the individual was very likely to be teaching one subject only. The trend toward teachers who taught one subject only became noticeable in city schools in the range of 101-200 pupils per grade. Throughout, this trend was more noticeable with biology and general science teachers than with chemistry and physics teachers.

22. Evidences of broadened curriculum became apparent in the larger schools. Subjects which were not found in any of the smaller schools have made their way into one or more of the larger city schools. There seems to be no uniformity of pattern with regard to these subjects, except that senior or physical science appears more likely to be found in the southwestern portion of the state. Conservation, photography, aeronautics, various types of chemistry, and various types of biology also represent attempts of individual schools to offer a broadened curriculum.

23. The older sciences of botany, zoology, and physiology seem to be entrenched more firmly in the curricula of the largest high schools. In these schools, 29 teachers devoted at least a major portion of their teaching day to these subjects. In 16 cases the teacher was teaching no other subject.

24. Aside from the teaching of senior science, physical science, physiology, botany, and zoology, there seems to be no basis for any attempt to discern "trends" in the teaching of the minor sciences in the cities. These minor sciences appear to be too scattered and too much localized to justify any such attempt. These subjects probably represent merely the efforts of strong-minded individuals, either science teachers or administrators, to fill a felt or imagined need at local level. In the rural schools, there were apparently two attempts which were planned at county level. Reference is made to the program of Coal Mining Science in Jefferson county and to Conservation in Trumbull county.

25. Almost ten per cent of the smallest schools in terms of pupil population offered one science only. Only a very few offered four sciences. Approximately sixteen per cent of the medium-sized county schools offered two science only, while almost half of them offered the three areas of general science, biology, and physics. Number of science offerings increased generally with pupil population. Mere size was not of itself a guarantee of a broad program, however, since some of the largest high schools offered only a few sciences.

26. Physiology was found in only 36 schools of the state, botany in 14 schools, and zoology in seven. On the other hand, senior science has found its way into 91 schools and was given in more schools than any other science aside from the standard four. Even war-born aeronautics was offered in more schools than were any of the old college-preparatory favorites, botany, zoology, physiology.

CHAPTER VIII

PERSONAL AND PROFESSIONAL QUALITIES OF OHIO'S SCIENCE TEACHERS

Many of the factors of competence which were discussed earlier, and which formed the center of investigation for this study have to do with the personal and professional qualities of the teacher, with methods of teaching, use of equipment, and with the more profound topic of functional philosophy. In order to obtain evidence concerning these items, the teachers of Ohio were contacted by means of a questionnaire sent to each teacher in the public secondary schools of Ohio who was listed in the Ohio high school principals' reports for the year 1950-51 as being a science teacher. A few schools, as noted in an earlier chapter, were not included because of the fact that their reports were not on file in the state department of education at the time the survey was begun.

However, a total of 2541 forms were sent to teachers of the state, during the spring of 1951, and of these 993 were returned either partially or completely answered. Of the 993, some 928 were considered complete enough to use, while the remainder were discarded because they were not of value commensurate with the effort required to interpret them. The city high school teachers returned their questionnaires comparable much better than did the teachers of the counties and exempted villages. However, replies

were received from at least one teacher in every city, exempted village, and county system.

Of the large cities, Cleveland was probably outstanding in that almost all of the teachers in that system who were addressed returned their forms in usable condition. Only one city school system registered disapproval through two of its teachers, but other science teachers in the same system reported by sending completed questionnaires.

Percentages of schools returning completed questionnaires are given as follows:

TABLE CCLXXXIV

PERCENT AND NUMBER OF QUESTIONNAIRES RETURNED BY TEACHERS IN
DIFFERENT TYPES OF SCHOOL SYSTEMS OF OHIO

Type School	Number Sent	Number Returned	Per cent
County and Exempted Village	1677	562	33.51
City Schools	864	431	49.90
Totals	2541	993	39.08

In all computations, the exempted village and county teachers have been grouped together, since a careful examination of the incoming data failed to reveal any significant differences as among the two groups. The data representative of the exempted

village teachers formed such a small grouping as compared with the other two that no useful purpose would have been served by creating separate tables unless wide divergences had been found. Since no divergences of any particular moment were developed, the classification was discarded, and these teachers were grouped with the teachers representing the smaller schools.

In the following pages, the headings for the various sections of the chapter consist of the questions as they appeared in the form sent to Ohio's teachers of science. The data concerned with the answers to the particular questions follow in order. For example, the first question related to work outside the school-room which had been engaged in by the instructor and which offered valuable experience for science teaching. The tabular (and other) answers to this question follow after the question heading. The county and exempted village teachers are considered first as a unit, then the same treatment is given the answers received from the Ohio city teachers.

County and Exempted Village Teachers

1. What types of work have you performed other than teaching which offered valuable experience so far as the teaching of science is concerned?

One of the very common criticisms made of teachers concerns their supposed lack of experience with anything in the "real" world. They are accused of being academic in their total outlook due to unfamiliarity with any activities other than those of the chalk-dust-laden schoolroom. In order to obtain firsthand evidence from the teachers concerning this common belief, the preceding question was propounded, together with a second question which requested the period of time spent in any outside activities listed in the original question. Answers to these two questions have been listed in tables and charts as follows:

TABLE CCLXXXV

NUMBER OF COUNTY AND EXEMPTED VILLAGE TEACHERS OF SCIENCE WHO CLAIMED THE FOLLOWING NUMBER OF TYPES OF VOCATIONAL EXPERIENCE OUTSIDE OF THE FIELD OF TEACHING WHICH HAVE SIGNIFICANCE FOR THE TEACHING OF SCIENCE

Number of Types of Outside Experience	Number of Teachers	Per cent of total number reporting
No Outside Experience	90	16.73
One General Type	171	31.78
Two General Types	196	36.43
Three General Types	79	14.68
More Than Three General Types	2	0.38
Total	538	100.00

The data of Table CCLXXXV indicate that the teachers reporting in the present study had a considerable degree of experience outside the classroom. In the county and exempted village groups listed herewith, some 83 per cent had outside experience, with over half reporting two or more general types of experience outside the classroom which had a direct bearing on the work of teaching the sciences. These data do not include experiences of many other types which might have been offered but which were not requested of the science teachers. Only those having a bearing on the teaching of science were included. The various types of science-related jobs reported together with the number of teachers listing various amounts of time spent in these jobs have been presented in Table CCLXXXVI.

TABLE CCLXXXVI

TYPES OF VOCATIONS LISTED BY OHIO'S COUNTY AND EXEMPTED VILLAGE
TEACHERS AND NUMBER OF TEACHERS LISTING VARIOUS AMOUNTS OF TIME
SPENT IN EACH OCCUPATION

Type of Occupation	Periods of Time Listed*					Totals
	(a)	(b)	(c)	(d)	(e)	
Chemist	3	9	17	5	7	41
Fabricating and Construction	35	32	31	8	20	126
Farming and Related	1	5	8	5	111	130
Forestry and Related	1	7	4	0	2	14
Gardening and Related	2	1	1	2	6	12
Health Clinic, etc.	0	1	1	0	0	2
Installation and Maintenance	3	5	4	1	8	21
Laboratory	24	29	24	9	10	96
Mechanical and Repairing	14	19	13	11	39	96
Mining	2	2	5	1	2	12
Processing	18	14	9	1	4	46
Railroad	3	4	1	2	4	14
Scientific Research	0	2	2	2	2	8
Service Related Experience	0	8	17	28	29	82
Steel Mill	16	20	7	9	11	63
Youth Work, Related	5	9	2	3	9	28
Miscellaneous	1	7	3	2	7	20
Totals	128	174	149	89	271	811

* Interpretation of the table is as follows:

(a) Less than six months' time; (b) From six months to one year; (c) One to two years; (d) Two or three years; (e) More than three years.

There probably also is some significance to be attached to the total amount of time spent in occupations aside from teaching which have some relation to the teaching of science. These are listed for the 538 teachers responding to this question as follows:

TABLE CCLXXXVII

TOTAL AMOUNT OF TIME SPENT IN SCIENCE-RELATED OCCUPATIONS BY 538
COUNTY AND EXEMPTED VILLAGE TEACHERS OF SCIENCE

Amount of Time	Number of Teachers in Each Category
None	90
Six months or less	36
Over six months to one year	35
More than one year to two years	63
More than two years to three years	67
More than three years to five years	119
Over five years	128
Total	538

3. What Hobbies have you developed which are useful to you in the teaching of science and how long have you had such hobbies?

Of the 538 teachers who responded to this question, 165 claimed to have no science-related hobby. However, the other 373

listed many different types of hobbies, a listing which has been presented in Table CCLXXXVIII.

So far as this particular sampling of teachers was concerned, photography appeared to be the most common hobby, with 124 teachers listing an area of interest in this field. Quite a number of teachers listed multiple hobbies, but no record was made of the number listing one, two, three, or more hobbies. The table follows:

TABLE CCLXXXVIII

SCIENCE-RELATED HOBBIES REPORTED BY 538 SCIENCE TEACHERS IN OHIO'S COUNTY AND EXEMPTED VILLAGE SCHOOLS

Type of Hobby	Periods of Time Listed*						Total
	(a)	(b)	(c)	(d)	(e)	(f)	
Astronomy, etc.	0	2	1	1	2	1	7
Collections	1	10	5	10	20	23	69
Greenhouse, Gardening, Floriculture	2	3	3	15	17	35	75
Hunting, Fishing	0	0	0	1	6	43	50
Mechanical, Construction	2	3	2	14	11	27	59
Minerology, Geology	0	2	0	3	1	1	7
Nature, etc.	0	5	12	5	15	30	67
Navigation	0	2	0	1	0	0	3
Photography, etc.	3	17	10	23	34	37	124
Radio, Electrical	3	3	3	11	12	17	49
Visual Aids	0	0	0	0	0	1	1
Youth Work, Camping	0	1	0	1	3	4	9
Totals	11	48	36	85	121	219	520

*

Periods of time are as follows:

(a) One year of less; (b) More-than-one-year to two years; (c) More-than-two to three years; (d) More-than-three to five years; (e) More-than-five to ten years; (f) More than ten years.

4. What school work have you completed which has been useful to you in the teaching of science, but which does not appear on your official transcript?

The education of a teacher is far broader than the formal courses in science, in education, and in physhology which he pursues in the college or university. It may be said to encompass all of the significant events of his life, but certain of these events may have had greater significance than others. Question 4 was asked in an attempt to determine something about possible areas of significant information about which would not be disclosed by state department records. Some 560 answers were received to this question, and have been classified in Table CCLXXXIX. Some few teachers listed more items than one, so that the total number of replies listed is greater than the number of teachers responding. Table CCLXXXIX follows:

TABLE CCLXXXIX

TYPES OF SCHOOLS ATTENDED BY 560 OF OHIO'S COUNTY AND EXEMPTED
VILLAGE SCIENCE TEACHERS OTHER THAN COLLEGES AND TEACHER TRAINING
INSTITUTIONS

Type of School	Number of Teachers
None	357
*Service Aviation or Engineering	17
Service Radio and Electrical	29
Service Laboratory School	3
Service Chemical Warfare	4
Service Photography	2
Service Navigation	13
Non-Service Radio and Electrical	8
Non-Service Refrigeration and Air-Conditioning	2
Non-Service Photography	1
Non-Service Laboratory	18
Non-Service Aviation	6
Red Cross First Aid, etc.	12
Vocational Schools, Apprenticeships, etc.	36
Special College Work	29
Non-College Youth Training	6
Miscellaneous Service Schools	37
Miscellaneous Non-Service Schools	6

*

By service schools are meant those which in any way
operated as a part of the Armed Services of the United States.

5. To what scientific or science teaching associations or organizations do you belong?

Of the number returning questionnaires, 539 individuals answered this question, with a total of 427 or 79.22 per cent indicating that they belonged to no organization of the types mentioned. Thus in the county and exempted villages, if the sampling was fair, only about one teacher of science in five belonged to any type of organization which has as its goal either a better understanding of science, better dissemination of science information, or improvements in the teaching of science. Of the associations reported, the National Science Teachers Association had the largest membership, with 36 of the respondees claiming membership in that organization.

Data follow in Table CCLXL:

TABLE CCEXL

MEMBERSHIPS IN VARIOUS SCIENCE AND SCIENCE-EDUCATION ASSOCIATIONS
REPORTED BY 539 COUNTY AND EXEMPTED VILLAGE TEACHERS OF SCIENCE

Organization	Number of Members
None	427
Acoustical Society of America	1
Amateur Weathermen	1
American Association for Advancement of Science	5
American Association of Physics Teachers	2
American Biology Teachers Association	10
American Chemical Society	12
American Ethnological Association	1
American Institute of Science and Engineering	1
American Meteorological Association	1
American Museum of Natural History	2
American Nature Study Society	1
American Physical Society	1
American Society of Mammalogists	1
Arctic Institute of North America	1
Central Association of Science and Mathematics Teachers	5
District Science Teachers Association	25
District or State Association (Any Science)	9
Division of Chemical Education of the American Chemical Society	2
Friends of the Land	2
Institute of Radio Engineering	1
Medical Fraternity	1
National Association for Research in Science Training	1
National Audubon Society	2
National Geographic Society	2
National Science Teachers Association	36
Ohio Academy of Science	26
Ohio Forestry Association	1
Science Clubs of America	1
Science Honorary	5
Wilson Ornithological Club	1

6. What science or science education magazine do you read regularly? Occasionally?

A total of 539 individuals gave intelligible answers to this question from among the replies received from county and exempted village schools. Of this number, 80, or almost fifteen per cent indicated that they never read any science or science education magazines. An additional 64 (or nearly 12 per cent) said that they read magazines of one of these types occasionally, but not regularly. Thus of the sampling, between 26 and 27 per cent indicated either that they read no current science or science-education literature, or that such reading was only occasional in nature. If the sampling was representative, over one-fourth of all of the teachers in the county and exempted villages who were teachers of science were getting little current information concerning either science itself or science education, at least so far as the printed page is concerned. Data relating to this question have been classified and presented in Tables CCXCI and CCXCII.

7. What science or science education books have you read in the past two years (aside from textbooks of secondary-school level?)

Bad as the picture may have seemed concerning reading of current literature, it appears to have been even worse in this respect. Of the 551 individuals answering this question, 351 confessed to have read nothing in this category within the preceding two years. Many of those who had read material confessed that it

was a portion of required college courses rather than as a part of an independent reading program. The data concerning this question have been placed in Table CCXCIII.

TABLE CCXCI

SCIENCE OR SCIENCE-RELATED MAGAZINES REPORTED READ REGULARLY BY
539 OHIO COUNTY AND EXEMPTED VILLAGE TEACHERS OF SCIENCE

Magazines Read Regularly	Number of Times Reported
No Magazines Read Regularly or Occasionally	80
No Magazines Read Regularly but one or More Read Occasionally	64
American Journal of Physics	7
Audobon	4
Biology Teacher	8
Chemical and Engineering Journal	5
Chemistry	18
Current Science and Aviation	71
Hygeia	9
Journal of Chemical Education	14
National Geographic	22
Nature	46
Nature Study	2
Ohio Conservation Bulletin	15
Ohio Academy Journal	8
Physics Today	2
Popular Mechanics	51
Popular Science	123
Radio and Television	2
School Science and Mathematics	16
Science	5
Science Digest	101
Science News Letter	73
Science News Weekly	5
Science Teacher	27
Scientific American	71
Scientific Monthly	15
Steelways	4
Today's Health	9
Trade Journals (several different)	22
Miscellaneous (mentioned once each)	46
Total reported read number of magazines	801
Average number of magazines reported read regularly per teacher reporting	1.48

TABLE CCXCII

SCIENCE OR SCIENCE-RELATED MAGAZINES REPORTED READ OCCASIONALLY
BY 539 OHIO COUNTY AND EXEMPTED VILLAGE TEACHERS OF SCIENCE

Magazines Read Occasionally	Number of Times Reported
Chemical and Engineering Journal	2
Chemistry	4
Current Science and Aviation	5
Hygeia	7
Journal of Chemical Education	6
National Geographic	14
Natural History	8
Nature	17
Ohio Conservation Bulletin	5
Physics Digest	2
Popular Mechanics	35
Popular Science	58
School Science and Mathematics	7
Science Digest	36
Science News Letter	16
Science Teacher	9
Scientific Monthly	3
Trade Journals (various)	10
Miscellaneous (mentioned once each)	23
Total reported read	299
Average number of magazines reported read occasionally per teacher reporting	0.55
Average number of magazines reported read regularly or occasionally by the teachers reporting*	2.03

*

See preceding table.

TABLE CCXCIII

SCIENCE AND SCIENCE-EDUCATION BOOKS REPORTED READ BY 551 COUNTY
AND EXEMPTED VILLAGE SCIENCE TEACHERS DURING THE TWO-YEAR PERIOD
PREVIOUS TO THE DATE OF THIS STUDY

Number of Books Reported Read*	Number of Teachers	Per cent of total
None	351	63.70
One or More Science Books	177	32.12
One or More Science Education Books	23	4.18
Total	551	100.00

*

A total of 414 books were reported read in the field of science, and 31 in the field of science education. Thus the "readers" read an average of 2.22 books each.

8. Please list any other pertinent factors of training which you believe have been of significance to you in your science teaching and which do not appear either in your college transcript or elsewhere in this supplemental list of questions.

A total of 545 teachers in the exempted village and county schools answered this question, with the great majority indicating that they could think of nothing to add to the training picture beyond that which had been previously ascertained. A rather wide variety of experiences were claimed by the 168 teachers who believed that there was more in their background of training than had been stated in response to earlier questions. The data have been reported in table CCXCIV which follows:

TABLE CCXCIV

ADDITIONAL FACTORS WHICH INFLUENCED THE TRAINING OF 545 COUNTY
AND EXEMPTED VILLAGE SCIENCE TEACHERS OF OHIO AS STATED BY
THESE TEACHERS

Factor of Training or Experience	Number of Teachers
None	377
Travel	42
Extensive Related Tours (as in industry)	23
Agriculture, 4-H, etc.	13
Kellogg Foundation Health	1
Special non-credit College of Laboratory Work	15
Vocational Teaching	1
Amateur Astronomy	2
Swimming, Life-Saving, etc.	8
Museum Study	6
Extensive Scientific Reading	13
Conservation Workshop, etc.	10
Extensive Scientific Research	5
Miscellaneous	47

9. What position of leadership do you hold in a church or in any church organization? Over how long a period of time have you held this or a similar position of leadership?

This question, and the next few succeeding questions related to the positions of leadership occupied by science teachers in the State of Ohio, and referred to Factor 4 in the original list of factors relating to effectiveness of science teaching. Data concerning question 9 are to be found in the succeeding tables.

The investigator believes, in the present instance, that more significance may be attached to the forty-three and a half per cent who were exerting leadership in church situations than to the 56.54 per cent who were not. While the results as herein given show less than one-half of the science teachers having been engaged in some church leadership, yet this proportion is far above that of the populace in general, and indicates in no small degree that science teachers do take church responsibilities and do hold positions of church leadership in the Ohio county and exempted village areas.

TABLE CCXCV

NUMBER AND PER CENT OF SCIENCE TEACHERS REPORTING POSITIONS OF LEADERSHIP IN CHURCH OR CHURCH-RELATED POSITIONS IN THE TWO YEARS PRIOR TO THIS STUDY--COUNTY AND EXEMPTED VILLAGES*

Number of Positions Held	Number of Teachers	Per cent
None	307	56.54
One Position	149	27.44
Two Positions	74	13.63
Three Positions	10	1.84
More than Three	2	0.55
Total	543	100.00

TABLE CCXCVI

LENGHT OF SERVICE AS A CHURCH LEADER AS REPORTED BY 237 OHIO
COUNTY AND EXEMPTED VILLAGE TEACHERS LISTED IN TABLE CCXCV

Length of Service	Number of Teachers
One year or less	37
More than one to two years	42
More than two to three years	23
More than three to five years	31
More than five to ten years	51
Over ten years	52
Totals	237

10. List any out-of-school activities involving youth in which you participate or have recently participated in a position of leadership.

Of the 543 teachers giving an intelligible answer to this question, a little over half were currently, or had very recently taken part in one or more activities involving youth outside the school. Quite a sizable number had worked with at least two such outside groups in a position of leadership. Again, the significant point in this particular situation is the high percentage of teachers who were taking part in such activities in comparison with the total number of adults in the community. Certainly no other

group of adults in the community could approach the teachers in this respect if the sampling reported is at all representative. Data follow:

TABLE CCXCVII

NUMBER AND PER CENT OF SCIENCE TEACHERS IN OHIO'S EXEMPTED VILLAGES AND COUNTY SCHOOLS REPORTING LEADERSHIP IN OUT-OF-SCHOOL YOUTH GROUPS (543 TEACHERS REPORTING)

Number of Groups Led	Number of Teachers	Per cent
None	256	47.15
One	211	38.85
Two	59	10.87
Three	15	2.76
Four or More	2	0.37
Total	543	100.00

TABLE CCXCVIII

TYPES OF ACTIVITIES SPONSORED BY 287 OHIO COUNTY AND EXEMPTED VILLAGE TEACHERS REPORTED IN TABLE CCXCVII*

Type of Activity	Number Reporting the Activity
Playground or Camp	30
Church Young People's Work*	50
Boy, Girl, or Cub Scout	139
YMCA or YWCA (non-School) Groups	21
Non-Church Youth Clubs	66
Non-School Athletics	51
Non-School, Non-Church Youth Instruction	24
Youth Scientific Expeditions	2

* Does not duplicate "positions of leadership" as listed in Tables CCXCV and CCXCVI.

11. List fraternal, social, or service organizations of which you are a member.

Pursuing the theme of community leadership and of the science teacher being a citizen in the community, an attempt was made to determine the numbers and types of organizations which science teachers have joined and in which they maintain membership in their communities. The three classifications of fraternal, social, and service were selected as being almost all-inclusive after the religious groups had been discussed.

Of the 540 teachers in the county and exempted villages answering the questions relating to organizational membership, 184 or 34.07 per cent claimed to belong to no organization in any of the three categories mentioned. Almost the same percentage reported membership in one organization, while the remaining individuals reported membership in more than one. The figures concerning these memberships have been listed in the two succeeding tables.

TABLE CCXCIX

NUMBER AND PER CENT OF SCIENCE TEACHERS REPORTING FROM OHIO'S COUNTY AND EXEMPTED VILLAGE SCHOOLS WHO BELONGED TO VARIOUS NUMBERS OF FRATERNAL, SOCIAL, OR SERVICE ORGANIZATIONS

Number of Organizations	Number Reporting Membership	Per cent
None	184	34.07
One	188	34.82
Two	108	20.00
Three	41	7.59
Four or More	19	3.52
Total	540	100.00

TABLE CCC

NUMBER AND TYPE OF AFFILIATIONS REPORTED BY 356 COUNTY AND EXEMPTED
VILLAGE TEACHERS REPORTING SUCH ORGANIZATIONAL MEMBERSHIPS

Type of Organization	Number of Member- ship Reported
1. Fraternal	
Masonic Bodies (except Eastern Star)	151
Eastern Star	22
American Legion	45
Veterans of Foreign Wars	12
Patrons of Husbandry (Grange)	80
Farm Bureau	12
Fraternal Order of Eagles	7
Knights of Pythias	9
Loyal Order of Moose	4
Sertoma	2
Knights of Columbus	6
Independent Order Odd Fellows (and Rebekahs)	13
Elks	6
Modern Woodmen of America	2
Disabled American Veterans	3
Miscellaneous	16
2. Social	
Men's (or Women's) Club	17
Greek Letter Fraternity or Sorority	61
Local Special Interest Group	41
3. Service	
Kiwanis	15
Civic	3
Parent Teachers Association	14
Lions	34
Rotary	6
Chamber of Commerce	12
YMCA or YWCA	5
Optimist	2
Exchange	2
American Association of University Women	2

12. List any "drives" or similar community movements in which you have taken an outstanding part in the past two years.

Of the 538 science teachers in the county and exempted village schools who answered this query, almost 60 per cent indicated that they had taken no part in any such community venture. However, this leaves somewhat over 40 per cent of the science teachers who had participated in one or more fund-raising drives. Some of the teachers had participated in more than four. Data concerning participation in drives has been presented in Table CCCII.

TABLE CCCII

NUMBER AND PER CENT OF COUNTY AND EXEMPTED VILLAGE SCIENCE TEACHERS WHO RESPONDED IN VARIOUS WAYS TO THE QUERY CONCERNING PARTICIPATION IN FUND RAISING DRIVES

Number of Drives	Number Participating	Per cent
None	322	59.85
One	125	23.23
Two	59	10.97
Three	22	4.09
Four	5	0.93
More than Four	5	0.93
Totals	538	100.00

TABLE CCCIII

TYPES OF DRIVE INDICATED BY 216 TEACHERS AND NUMBER OF TIMES EACH SUCH DRIVE WAS LISTED BY THESE TEACHERS (THE PARTICIPANTS OF TABLE CCCII)

Type of Drive	Number of Times Mentioned
Red Cross	122
March of Dimes	29
Community Chest	33
Salvation Army	3
Tuberculosis Drive	10
Crippled Children	11
School Drives	31
Cancer	19
Religious or Church Drives	16
Local Non-School, Non-Church Drives	45
Boy Scouts	15
YMCA	8
Heart	3
Poppy Drive	1
Civilian Defense	5
CARE	2

13. Do teachers in your community usually or often assume positions of leadership in movements for the common good?

Teacher judgment was requested in this query, and there may be those who will quarrel with this method of obtaining an answer. However, there probably is no better method for determining an answer short of an extensive survey. By and large the teachers probably know whether or not community movements for the common

good are usually or often sparked by teachers. Their responses evidence only a small percentage of teachers who were unwilling to state an answer. Of 538 teachers responding, only 16 would not venture a positive stand on the question. The tabulation on this question was as follows:

Yes	388	72.12 per cent
No	134	24.91 per cent
Not Sure	16	2.97 per cent
Total	538	100.00 per cent

14. Do you believe that your community permits teachers to live a "normal" life?

This question called forth some rather violent disagreement. Most teachers believed, however, that the teacher was able to live normally in the community, although many felt otherwise. Many comments accompanied the "Yes" and "No" answer on this question. Apparently it is a question about which teachers feel deeply one way or another, and a question on which they are unusually likely to express an opinion. There were 537 answers, and of those only eight were non-committal. Thus, the score was:

Yes	412	76.72 per cent
No	117	21.79 per cent
Non-committal	8	1.49 per cent
Total	537	100.00 per cent

15. List your school responsibilities aside from teaching.

The responsibilities of science teachers in the county and exempted village schools are as many and varied as the hues of the rainbow. Science teachers are driving school buses, are caring for school libraries, directing school plays, and above all, in great numbers are coaching. As a matter of fact, 40 per cent of the science teachers in these two groups of schools who answered the questionnaire were coaching one or more sports. No other activity outdistanced coaching as a side duty of science teachers in these smaller schools, and the only one to approach it was the matter of sponsorship of clubs or classes. Here 177 of the 558 teachers responding listed duties. Only 23 of the teachers, a really negligible percentage indicated that they had no duties other than in connection with the regular teaching of the school-day. For all of the teachers responding, the per capita number of extra duties was 1.92, or almost two extra-curriculum activities per teacher. A list of such activities has been made in Table CCCIV.

TABLE CCCIV

NON-TEACHING DUTIES OF 558 OHIO SCIENCE TEACHERS IN THE COUNTY
AND EXEMPTED VILLAGE SCHOOLS

Non-Teaching Duty	Number of Teachers
None	23
Athletics or Coaching	227
School Clubs or Classes	177
Administration or Supervision	108
Counselor or Advisor	98
Hall, Home Room, or Noon Duty	75
Visual Aids Director	62
Dramatics and Debate	54
Publications	36
Tickets	36
Teachers Association, PTA, etc.	35
Dances, Social Events, Activities	29
Cafeteria, Lunch Room, Banquets	20
Bus Driver or Bus Duty	18
Playground	15
Librarian	12
Finance	11
School Assemblies	9
Musical Productions	8
Clerical Work	8
Curriculum	6
Attendance	5
Testing	5
Exhibit Supervisory	4
School Greenhouse	2
School Store	2
Maintenance	2
Health Work	3
Photography	1
First Aid	1
Public Relations	1
Total	1093

16. Do you believe that the amount of time and energy taken by your school responsibilities other than teaching are detrimental to your teaching or that these activities help your teaching?

Although only one teacher in five felt that his extra-curricular activities hurt his teaching, only two of five felt that these activities were of definite help. The remaining teachers either felt that there was no difference apparent, or were qualified in their answers. The tabulation of the responses follows in Table CCCV.

TABLE CCCV

BELIEFS OF 541 COUNTY AND EXEMPTED VILLAGE SCIENCE TEACHERS CONCERNING BENEFITS TO OUR DAMAGES TO TEACHING DONE BY THE EXTRA-CURRICULAR LOAD BEING CARRIED AT THE TIME THIS SURVEY WAS MADE

Condition	Number of Teachers	Per cent
Harmful	112	20.70
Helpful	229	42.33
No Difference	150	27.73
No Acitivities	23	4.25
Qualified Answer	27	4.99
Total	541	100.00

17. Do you believe that the community work you are required to do because you are a teacher hurts your efficiency as a teacher or makes you a better teacher?

The wording of this question may have been somewhat unfortunate, since perhaps a dozen teachers insisted in their answers that they were not, because they were teachers, required to do community work. However, the intent of the question was apparently understood by most teachers, and only a handful gave qualified answers. There was much less feeling among the 530 teachers who responded that community work was harmful to their teaching. Only about one teacher of twenty felt thus about the community work in which he was engaged. On the other hand, not too many more believed it was helpful than in the case of the preceding question. The big difference was in the number who felt that community work neither hurt nor helped their efficiency as a teacher. The numbers and percentages in each group have been listed in Table CCCVI.

TABLE CCCVI

BELIEFS OF COUNTY AND EXEMPTED VILLAGE SCIENCE TEACHERS OF OHIO
CONCERNING PROBABLE VALUE TO OR DETRIMENT OF THEIR TEACHING BECAUSE
OF REQUIRED COMMUNITY WORK

Condition	Number of Teachers	Per cent
Harmful	29	5.47
Helpful	246	46.41
No Difference	228	43.02
No Activities	16	3.02
Qualified Answer	11	2.08
Totals	530	100.00

18. How much time do you spend during the regular school year in some gainful occupation other than your regular school work?

Almost half of the teachers who responded to this query indicated that school work was their full-time job during the school months. However, slightly more than one-half of these county and exempted village science teachers had some kind of job which required part of their time during the teaching season. One out of eleven of the teachers in these categories was working over twenty hours per week and at the same time teaching school. Data follows in Table CCCVIII.

TABLE CCCVII

NUMBER OF HOURS PER WEEK SCIENCE TEACHERS (538 COUNTY AND EXEMPTED VILLAGE) WERE GAINFULLY EMPLOYED IN OCCUPATIONS OTHER THAN TEACHING DURING THE SCHOOL YEAR

Number of Hours	Number of Teachers	Per cent
None	260	48.33
One to Ten Hours	164	30.48
Eleven to Twenty Hours	66	12.27
Over Twenty Hours	48	8.92
Total	538	100.00

16. List your curricular load in terms of number of pupils taught, and number of preparations per day, also number of study halls per day.

Data extracted from the responses to this series of questions may be compared directly with those emanating from the data gathered in the files of The Ohio State Department of Education. Following are the three tables which contain the information furnished by the 538 teachers who responded to the questions given.

TABLE CCCVIII

NUMBER OF PUPILS REPORTED PER TEACHER BY 538 COUNTY AND EXEMPTED
TEACHERS OF SCIENCE IN OHIO

Number of Pupils per Teacher	Number of Teachers	Per cent of total
0 - 25	22	4.09
26 - 50	34	6.32
51 - 75	68	12.64
76 - 100	114	21.19
101 - 125*	100	18.59
126 - 150	96	17.84
151 - 175	54	10.04
176 - 200	33	6.13
201 and over	17	3.16
Total	538	100.00

* The median lay in the 101-125 bracket.

TABLE CCCIX

NUMBER OF PREPARATIONS PER DAY REPORTED BY 538 COUNTY AND EXEMPTED
VILLAGE SCIENCE TEACHERS IN OHIO

Number of Preparations	Number of Teachers	Per cent
One	21	3.91
Two	75	13.94
Three	101	18.77
Four*	114	21.19
Five	142	26.39
Six	70	13.01
Seven	15	2.79
Total	538	100.00

*

The median was four preparations per day.

TABLE CCCX

NUMBER OF STUDY HALLS PER DAY REPORTED BY 538 COUNTY AND EXEMPTED
VILLAGE TEACHERS IN OHIO

Number of Study Halls	Number of Teachers	Per cent
None	120	22.30
One	232*	43.12
Two	142	26.39
Three	37	6.87
Four	6	1.12
Five	1	0.19
Total	538	100.00

*

The median is one study hall per day.

Returns from City Science Teachers

The returns from the questionnaires sent to city teachers of science have been handled in a fashion as nearly identical with the treatment given the county and exempted village teachers as possible. Tables are in all cases comparable with tables in the earlier part of this chapter. Thus Table CCCXI compares with Table CCLXXXV, etc.

As in the treatment of the county and exempted village groups, the question as asked in the questionnaire precedes the discussion and tabular matter. It is well to remember that the city teachers represent an older group of individuals than the county and exempted village groups. This factor of age and experience causes some variation in returns, but its significance is difficult to measure.

1. What types of work have you performed other than teaching which offered valuable experience so far as the teaching of science is concerned? Over how long a period of time did such experience extend?

Answers to these two questions have been listed in Tables CCCXI and CCCXII.

TABLE CCCXI

NUMBER OF CITY TEACHERS OF SCIENCE WHO CLAIMED THE FOLLOWING NUMBER OF TYPES OF VOCATIONAL EXPERIENCE OUTSIDE THE FIELD OF TEACHING, WHICH HAVE SIGNIFICANCE FOR THE TEACHING OF SCIENCE

Number of Types of Outside Experience	Number of Teachers	Per cent of Total Number Reporting
No outside experience	47	12.05
One general type	120	30.77
Two general types	126	32.31
Three general types	88	22.56
More than three types	9	2.31
Total	390	100.00

TABLE CCCXII

TYPES OF VOCATIONS LISTED BY OHIO'S CITY SCIENCE TEACHERS AND NUMBER OF TEACHERS LISTING VARIOUS AMOUNTS OF TIME SPENT IN EACH OCCUPATION

Type of Occupation	Periods of Time Listed*					Totals
	(a)	(b)	(c)	(d)	(e)	
Chemist	7	9	5	4	8	33
Engineer	2	5	3	1	4	18
Fabricating and Construction	19	28	19	11	16	93
Farming and Related	1	5	3	4	59	72
Forestry and Related	2	2	3	3	6	16
Gardening and Related	1	1	2	2	19	25
Health Clinic, etc.	1	2	5	0	4	12
Installation and Maintenance	3	9	3	1	4	20
Mechanical and Repairing	9	23	13	15	23	83
Mining	0	1	1	1	2	5
Processing	5	15	2	4	11	37
Railroad	1	3	1	1	1	7
Scientific Research	0	2	2	4	6	14
Service Related Experience	1	7	13	23	16	60
Steel Mill	12	16	9	5	13	55
Youth Work, Related	5	3	5	10	21	44
Miscellaneous	2	2	4	1	8	17
Totals	80	150	117	99	235	681

* Interpretation of table is as follows:

(a) Less than six months' time; (b) From six months to one year; (c) One to two years; (d) Two to three years; (e) More than three years.

TABLE CCCXIII

TOTAL TIME SPENT IN SCIENCE-RELATED OCCUPATIONS BY 390 CITY TEACHERS
OF SCIENCE IN OHIO

Amount of Time	Number of Teachers in Each Category
None	47
Six months or less	16
Over six months to one year	18
Over one year to two years	32
Over two years to three years	41
Over three years to five years	67
Over five years	169
Total	390

3. What hobbies have you developed which are useful to you in the teaching of science and how long have you had such hobbies?

Of the 404 teachers responding to this question, only 64 claimed to have no science-related hobby. This is a much lower percentage than in the case of the rural and exempted village teachers, where 165 of 538 said they had no such hobby. Additionally, the total number of hobbies named by the 404 teachers was almost as great as the total listed by the 538 teachers in the smaller schools. As with the rural teachers, photography was the most popular science-related hobby, listing 113 devotees. Data have been presented in Table CCCXIV.

TABLE CCCXIV

SCIENCE-RELATED HOBBIES REPORTED BY 404 CITY TEACHERS OF SCIENCE
IN OHIO'S SCHOOLS

Type of Hobby	Periods of Time Listed*						Totals
	(a)	(b)	(c)	(d)	(e)	(f)	
Astronomy	0	1	0	1	0	2	4
Collections	2	2	2	4	12	26	48
Geology	0	0	0	0	2	2	4
Greenhouse and Gardening	0	1	4	7	17	58	87
Hunting and Fishing	0	0	0	3	3	18	24
Husbandry, Horticulture, etc.	0	0	0	4	5	10	19
Mechanical and Construction	1	6	0	7	21	15	50
Nature	0	3	2	3	11	45	64
Navigation and Meteorology	0	0	0	2	0	0	2
Photography	3	4	5	18	28	55	113
Radio and Electrical	1	2	2	9	6	11	31
Youth Work, Camping, etc.	0	0	2	1	4	21	28
Miscellaneous	0	1	0	2	6	9	18
Totals	7	20	17	61	115	272	492

*

Periods of time are as follows:

(a) One year or less; (b) More than one to two years;
(c) More than two to three years; (d) More than three to five
years; (e) More than five to ten years; (f) More than ten years.

4. What school work have you completed which has been useful to you in the teaching of science, but which does not appear on your official transcript?

Of 412 city teachers of science answering this question, some 221 indicated that they had no schooling in addition to that which appeared on their official transcript. However, 191 or about 46.3 per cent indicated that they had received some form of schooling in addition to that which normally is included in a college transcript. This percentage is considerably higher than that which was claimed by the teachers of science in Ohio's smaller schools. Table CCCXV has been drawn to indicate the types of schoolings listed by the city teachers which is over and above their regular college work.

TABLE CCCXV

TYPES OF SCHOOLS ATTENDED BY 412 OF OHIO'S CITY TEACHERS OF SCIENCE
OTHER THAN COLLEGES AND TEACHER TRAINING INSTITUTIONS

Type of School	Number of Teachers Attending
None	221
Service Aviation or Engineering	7
Service Radio and Electrical	16
Service Laboratory School	9
Service Chemical Warfare	1
Service Photography	1
Service Navigation and Meteorology	10
Non-service Radio and Electrical	9
Non-service Photography	5
Non-service Laboratory	10
Non-service Aviation	7
Red Cross First Aid, etc.	16
Vocational Schools, Apprenticeships, etc.	29
Special College Work	55
Non-college Youth Training	7
Miscellaneous Service Schools	19
Miscellaneous Non-service Schools	22

5. To what scientific or science teaching associations or organizations do you belong?

Of the 426 city teachers returning answers to this question, 188 gave indication that they belonged to no organizations of the type mentioned. This percentage of 44.13 per cent who do not belong to any organization compares very favorably with the 79.22 per cent of the rural teachers who are similarly situated. The 238 city teachers who do present organizational memberships had 365 memberships in science and science-education organizations, making for these individuals an average of over 1.5 memberships each. Data concerning organizational memberships have been listed in Table CCCXVI.

TABLE CCCXVI

MEMBERSHIPS IN VARIOUS SCIENCE AND SCIENCE-EDUCATION ASSOCIATIONS
REPORTED BY 426 CITY TEACHERS OF SECONDARY SCIENCE

Organization	Number of Memberships
None	188
American Association for the Advancement of Science	27
American Association of Physics Teachers	1
American Biology Teachers Association	38
American Chemical Society	16
American Forestry Association	1
American Museum of Natural History	1
American Nature Study Society	4
American Radio Relay League	1
American Social Hygiene Association	1
Audobon Society	5
Burroughs Nature Club	1
Central Association of Science and Mathematics Teachers	21
District or State Science Association	12
District or State Science Teachers Association	87
Friends of the Land	1
Institute of Radio Engineers	2
Local Science or Science Education Association	4
National Geographic Society	6
National Science Teachers Association	52
Ohio Academy of Science	46
Ohio Forestry Association	1
Science Honoraries	18
Miscellaneous (Lesser known organizations)	19

6. What science or science education magazines do you read regularly? Occasionally?

City teachers apparently are better readers of professional literature than are their rural counterparts. Whereas over 14 per cent of the rural and exempted village teachers indicated that they read no current professional literature in the science or science-related area, in the city schools the percentage was a little over eight per cent. The average number of magazines read per teacher was greater both for the number read regularly and for the number read occasionally. These figures for the city teachers were 1.90 for magazines read regularly and 0.60 for those occasionally read; for the county and exempted village teachers the corresponding figures were 1.48 and 0.55.

Differences were noted also in connection with the type of magazines read. Percentagewise, considering the number of magazines read by both groups, the popular science and popular mechanics type of magazine tended to be less popular with the city teachers than with their rural counterparts. Scientific American, and some of the science teacher's magazines were, on the other hand, more popular with the city teachers.

The range of magazines read by city teachers was not appreciably different from that read by the teachers in the smaller schools. Few appear on one list that do not appear somewhere on the other. Perhaps this result might have been foretold, since

the magazines listed run the gamut of scientific and science-education interests. Science News Letter and Science Digest appear to have great popularity with both groups. Of the professional magazines, The Science Teacher, organ of the National Science Teachers Association appears to have had the greatest popularity in the sampling studied. Data have been given in Tables CCCXVII and CCCXVIII.

TABLE CCCXVII

SCIENCE OR SCIENCE-RELATED MAGAZINES REPORTED READ REGULARLY BY
428 CITY SCIENCE TEACHERS IN THE OHIO SECONDARY SCHOOLS

Magazines Read Regularly	Number of Times Reported
No Magazines read regularly or occasionally	35
No Magazines read regularly but one or more read occasionally	25
Audobon	8
Biology Teacher	20
Canada Nature	2
Chemical and Engineering News	6
Chemistry	22
Current Science and Aviation	22
Hygeia	6
Journal of American Chemical Society	3
Journal of Chemical Education	22
Mechanix Illustrated	7
National Geographic	28
Natural History	24
Nature	44
Ohio Conservation Bulletin	22
Ohio Academy Journal	15
Photography	2
Physics Review	3
Popular Mechanics	35
Popular Science	77
School Science and Mathematics	22
Science	17
Science Digest	84
Science News Letter	98
Science Teacher	43
Scientific American	101
Scientific Monthly	17
Today's Health	12
Trade Journals (several different)	25
Miscellaneous (mentioned once each)	30
Total reported read	817
Average number of magazines reported read regularly per teacher reporting	1.90

TABLE CCCXVIII

SCIENCE OR SCIENCE-RELATED MAGAZINES REPORTED READ OCCASIONALLY BY
428 OHIO CITY TEACHERS OF SECONDARY SCIENCE

Magazines Read Occasionally	Number of Times Reported
Biology Teacher	3
Chemistry	4
Current Science and Aviation	8
Hygeia	6
Journal of Chemical Education	5
National Geographic	11
Natural History	9
Nature	18
Ohio Conservation Bulletin	4
Ohio Journal of Science	4
Popular Mechanics	21
Popular Science	37
School Science and Mathematics	11
Science Digest	21
Science Education	2
Science News Letter	11
Science Teacher	4
Scientific American	26
Scientific Monthly	2
Trade Journals	12
Miscellaneous	37
Total reported read	257
Average number of magazines reported read occasionally, per teacher reporting	0.60
Average number of magazines reported read regularly or occasionally by the teachers reporting*	2.50

*

See preceding table.

7. What science or science-education books have you read in the past two years (aside from textbooks of secondary-school level?)

The city teachers were better readers than were their rural counterparts so far as their reading of science and science-related books was concerned. Whereas in the rural schools, 63.70 per cent of the teachers who reported confessed that they had read no books concerning either of these fields within the preceding two years, with the city teachers the figure was 47.38 per cent or less than one teacher of every two. These data have been presented in Table CCCXIX.

TABLE CCCXIX

SCIENCE AND SCIENCE-EDUCATION BOOKS REPORTED READ BY 382 CITY TEACHERS OF SCIENCE IN OHIO'S SECONDARY SCHOOLS*

Number of Books Reported Read	Number of Teachers	Per cent of total
None	181	47.38
One or More Science Books	176	46.07
One or More Science- Education Books	43	11.26

*

In this table, totals are meaningless, since some teachers who read science books also reported science-education books. A total of 554 science books and 79 science education books were reported read.

8. Please list any other pertinent factors of training which you believe have been of significance to you in your science teaching and which do not appear either in your college transcript or elsewhere in this supplemental list of questions.

For the city teachers as a whole, 426 answers were received. Of these, 214 or almost exactly half indicated that there was nothing in their earlier experience which would warrant mention here. The experiences mentioned by the other 212 individuals paralleled roughly those offered by the county and exempted village teachers. They have been treated in Table CCCXX.

TABLE CCCXX

ADDITIONAL FACTORS WHICH INFLUENCED THE TRAINING OF 426 CITY
HIGH SCHOOL TEACHERS OF SECONDARY SCIENCE IN OHIO

Factor of Training or Experience	Number of Teachers
None	214
Travel	50
Extensive Related Tours (as in industry)	36
Agriculture, 4-H, etc.	9
Health Education (Kellogg, etc.)	15
Special non-credit college or laboratory work	40
Museum Experience	2
Extensive Reading, etc.	19
Conservation Workshops, etc.	15
Extensive Scientific Research	8
Diversified Life Experiences	28
Scientific Writing	4
Miscellaneous (items mentioned once)	40

9. What position of leadership do you hold in a church or in any church organization? Over how long a period of time have you held this or a similar position of leadership?

Perhaps due to their greater age and longer service in the community, the city teachers had a somewhat greater percentage of their number who were leaders in church or church-related organizations. Of the 386 teachers from the city schools answering this question, 188 or 48.71 per cent indicated that they were church leaders. On the other hand, some of these teachers indicated that in their earlier years they had held positions but had become inactive in leadership because of other duties.

Data concerning number of positions held and length of service have been presented in Tables CCCXXI and CCCXXII.

TABLE CCCXXI

NUMBER AND PER CENT OF CITY SCIENCE TEACHERS REPORTING POSITIONS OF LEADERSHIP IN CHURCH OR CHURCH-RELATED POSITIONS IN THE TWO YEARS PRIOR TO THIS STUDY (386 TEACHERS REPORTING)

Number of Positions Held	Number of Teachers	Per cent
None	198	51.29
One Position	103	26.68
Two Positions	59	15.29
Three Positions	18	4.67
More than three positions	8	2.07
Total	386	100.00

TABLE CCCXXII

LENGTH OF SERVICE AS A CHURCH LEADER AS REPORTED BY 188 OHIO CITY TEACHERS OF SCIENCE LISTED IN TABLE CCCXXI

Length of Service	Number of Teachers
One year or less	11
More than one to two years	26
More than two to three years	17
More than three to five years	25
More than five to ten years	39
Over ten years	70
Total	188

10. List any out-of-school activities involving youth in which you participate or have recently participated in a position of leadership.

Of the 386 city teachers who answered this question, about 54 per cent indicated that they either were at the time or had recently participated in leadership of out-of-school youth organizations. This percentage was somewhat higher than was the case for the teachers in the smaller schools, but not significantly so, since there was only approximately one per cent separation between the two groups. Again, as with the rural teachers, the chief significance is in the very great community participation of the teaching groups in out-of-school youth work. Data have been listed in Tables CCCXXIII and CCCXXIV.

TABLE CCCXXIII

NUMBER AND PER CENT OF SCIENCE TEACHERS IN OHIO'S CITY SCHOOLS OF 386 REPORTING WHO INDICATED LEADERSHIP IN OUT-OF-SCHOOL YOUTH ORGANIZATIONS

Number of Groups Led	Number of Teachers	Per cent
None	178	46.12
One	149	38.60
Two	48	12.44
Three	8	2.07
Four or More	3	0.77
Total	386	100.00

TABLE CCCXXIV

TYPES OF ACTIVITIES SPONSORED BY 208 OHIO CITY TEACHERS OF SCIENCE
REPORTED IN TABLE CCCXXIII

Type of Activity	Number Reporting the Activity
Playground or Camp	31
Church Young People's*	26
Boy, Girl, or Cub Scouts	101
YMCA or YWCA (Non-school) Groups	35
Non-church Youth Clubs	45
Non-school Athletics	15
Non-school, Non-church Youth Instruction	25

*

Does not duplicate listings of church leadership.

11. List fraternal, social, or service organizations of which you are a member.

City teachers seemed to belong to organizations to a somewhat lesser extent than did their rural counterparts if the results of this survey may be considered representative. Again, however, the difference, percentagewise, was not great. Not only was the percentage of city teachers who belonged to any organizations somewhat lower, but the score was lower all along the line. Thus there was a smaller percentage of teachers belonging to one organization, to two, to three, and to more than three. The number of city teachers belonging to four or more was so small as not to

be of importance. The city teacher seems to be somewhat less "organization minded" if all other factors may be considered equal. Since the city teachers as a group are an older body of teachers than the rural representatives, the normal expectation would be that they should belong to a somewhat greater number of organizations. The fact that they belong to less probably does represent a real difference between the two groups of teachers.

Perhaps quite a bit of the difference comes because of the position held by the Grange and Farm Bureau in the lives of many rural teachers.

TABLE CCCXXV

NUMBER AND PER CENT OF OHIO'S CITY TEACHERS OF SCIENCE WHO BELONG TO VARIOUS NUMBERS OF FRATERNAL, SOCIAL, OR SERVICE ORGANIZATIONS

Number of Organizations	Number Reporting Membership	Per cent
None	141	36.91
One	128	33.51
Two	75	19.63
Three	28	7.33
More than Three	10	2.62
Total	382	100.00

TABLE CCCXXVI

NUMBER AND TYPE OF AFFILIATIONS REPORTED BY 208 CITY TEACHERS
OF SCIENCE REPORTING SUCH ORGANIZATIONAL MEMBERSHIPS

Type of Organization	Number of Memberships Reported
1. Fraternal	
Masonic Bodies (except Eastern Star)	121
Eastern Star	9
American Legion	28
Veterans of Foreign Wars	2
Patrons of Husbandry (Grange)	17
Farm Bureau	1
Fraternal Order of Eagles	3
Knights of Pythias	7
Loyal Order of Moose	2
Knights of Columbus	1
Independent Order Odd Fellows	1
Elks	10
Daughters of American Revolution	5
Daughters of America	1
Society of Mayflower Descendants	2
Miscellaneous	13
2. Social	
Men's (or Women's) Club	17
Greek Letter Fraternity or Sorority	64
Local Special Interest Group	41
Executive	2
3. Service	
Kiwanis	4
Lions	11
Rotary	1
Exchange	2
Chamber of Commerce	4
American Association University Women	8
YMCA or YWCA	9
Optimist	1

12. List any "drives" or similar community movements in which you have taken an outstanding part in the past two years.

The city science teachers represented in this sampling took part in community fund drives to a slightly greater extent than did the rural teachers. While not quite half of the teachers did take a leading part, the fact that nearly half of them did so is an item of significance. This percentage is certainly much higher than would be found in many other groups of people.

Data have been tabulated in Tables CCCXXVII and CCCXXVIII.

TABLE CCCXXVII

NUMBER AND PER CENT OF CITY SCIENCE TEACHERS WHO RESPONDED IN VARIOUS FASHIONS TO THE QUERY CONCERNING PARTICIPATION IN COMMUNITY DRIVES

Number of Drives	Number Participating	Per cent
None	216	56.10
One	98	25.45
Two	47	12.21
Three	16	4.16
Four	8	2.08
Total	385	100.00

TABLE CCCXXVIII

TYPES OF DRIVE INDICATED BY 273 CITY TEACHERS AND NUMBER OF TIMES
EACH DRIVE WAS LISTED BY THESE TEACHERS

Type of Drive	Number of Times Mentioned
Red Cross	73
March of Dimes	11
Community Chest	56
Salvation Army	2
Tuberculosis Drive	2
Crippled Children	3
School Drives	15
Cancer	12
Religious or Church Drives	22
Local Non-School, Non-Church Drives	26
Boy Scouts	7
YMCA, YWCA	24
Heart	1
Civilian Defense	14
CROP, CARE	5

13. Do teachers in your community usually or often assume positions of leadership in movements for the common good?

Slightly more than four of every five city teachers of science believed that teachers in their areas did assume positions of leadership in movements for the common good. This percentage is significantly higher than is the case with the rural and exempted village teachers who answered this question. Only seven of ten

of these teachers responded similarly. Following is the tabulation.

Yes	310	80.10 per cent
No	62	16.02 per cent
Not Sure	15	3.88 per cent
Total	387	100.00 per cent

14. Do you believe that your community permits teachers to live a "normal" life?

The rather astonishing factor in tabulation of the answers to this question was the fact the slightly more than nine out of ten city teachers of science who responded to this question believe that their communities do permit them to lead a normal life as they define normality. This percentage is significantly higher than is the case of the rural and exempted village schools where, percentagewise, almost three times as many indicated their belief that a normal life was not possible for teachers in their community. The data follow:

Yes	351	90.70 per cent
No	30	7.75 per cent
Non-committal	6	1.55 per cent
Total	387	100.00 per cent

15. List your school responsibilities aside from teaching.

To this question, 411 teachers responded with varying items.

Generally speaking, the rural and the city teachers seem to be about equally responsible for extra-curricular (or at least extra-teaching) duties. The city teacher has slightly more (2.00 each as compared with 1.92 for the rural teacher) but the difference is too small to be very meaningful. Some differences in type of activity are noticeable, however. The rural teacher is much more likely to be a coach. The city teacher is much more likely to be a club or class sponsor. The rural teacher is much more likely to be in administration or supervision. The city teacher is considerably more likely to be the director of audio-visual aids, or to hold considerable responsibility in that area.

Following is a tabulation of these extra-class duties.

TABLE CCCXXIX

NON-TEACHING DUTIES OF 411 OHIO CITY SCIENCE TEACHERS

Non-class Duty	Number of Teachers
None	18
Athletics or Coaching	92
School Clubs or Classes	220
Administration or Supervision	40
Guidance	57
Hall, Home Room, or Noon Duty	85
Visual Aids Director	79
Dramatics and Debate	15
Publications	14
Tickets	28
Teachers Association, PTA, etc.	86
Dances, Social Events, Activities	25
Cafeteria, Lunchrooms, etc.	16
Bus Duty	2
Playground	2
Librarian	1
Finance	6
School Assemblies	14
Musical Productions	3
Clerical Work	6
School Greenhouse	2
Nurse	4
Photography	8
Public Relations	1
Total	825

16. Do you believe that the amount of time and energy taken by your school responsibilities other than teaching are detrimental to your teaching or that these activities help your teaching?

More teachers in the city group were non-committal concerning the damage to their teaching or the aid given it by their extra-class responsibilities. Correspondingly, there were less who believed that the work hurt their teaching and less who believed that it helped. Almost 40 per cent of all of the city science teachers responding to this question believed that the extra-curricular work neither hurt nor helped them in their teaching. Only about one out of eight felt that his work was harmed, while approximately two out of every five believed that their class work was benefited by their extra duties. As with the rural teachers, a few qualified their statements and a few had no activities to report. Data have been presented in Table CCCXXX.

TABLE CCCXXX

BELIEFS OF 387 CITY TEACHERS OF SCIENCE CONCERNING BENEFITS TO OR DAMAGES TO TEACHING DONE BY THE NECESSITY FOR CARRYING OUT CERTAIN EXTRA-CLASS DUTIES

Condition	Number of Teachers	Per cent
Harmful	50	12.92
Helpful	144	37.21
No Difference	152	39.28
No Activities	18	4.65
Qualified Answer	23	5.94
Total	387	100.00

17. Do you believe that the community work you are required to do because you are a teacher hurts your efficiency as a teacher or makes you a better teacher?

With the county, the exempted village, and the city teachers, probably the most impressive factor is the very small number of teachers who feel that their community work hurts their teaching. Particularly is there validity to this statement in the cities, where only a few more than two per cent of the teachers felt that their work was hurt by the fact that certain community requirements do sometimes make their weight felt. One factor which is to be kept in mind is that this condition has been recorded in the face of the fact that these teachers were carrying, per capita, far more community work, church leadership, and organizational responsibility than is true for the great mass of the populace. The results seem to indicate that these teachers liked to serve and that they did not feel hemmed in by their service. Almost half of the city teachers saw their community work as having value for their teaching. Perhaps the most outstanding item reported in this tabulation is that which shows that of the 382 city science teachers reporting, only six individuals, or just about one and a half per cent did not report some type of community service.

TABLE CCCXXXI

BELIEFS OF 382 CITY SCIENCE TEACHERS OF OHIO CONCERNING PROBABLE
VALUE TO OR DETRIMENT TO THEIR TEACHING BECAUSE OF REQUIRED
COMMUNITY WORK

Condition	Number of Teachers	Per cent
Harmful	9	2.36
Helpful	183	47.90
No Difference	167	43.72
No Activities	6	1.57
Qualified Answer	17	4.45
Total	382	100.00

18. How much time do you spend during the regular school year in some gainful occupation other than your regular school work?

Percentages listed for city teachers varied but little from those listed for teachers in the smaller schools insofar as this question of extra-contractual work was concerned. The per cent of those not working for pay at extra jobs during the school year was slightly, but not significantly higher for city teachers. Over four-fifths of the city teachers reported either that they did not work for pay in any position aside from their regular teaching position during the year or that they worked ten hours or less per week. Data have been listed in Table CCCXXXII.

TABLE CCCXXXII

NUMBER OF HOURS OF EXTRA-CONTRACTUAL GAINFUL EMPLOYMENT PER WEEK
REPORTED BY 388 CITY TEACHERS OF SECONDARY SCIENCE IN OHIO

Number of Hours	Number of Teachers	Per cent
None	192	49.48
One to Ten Hours	125	32.22
Eleven to Twenty Hours	49	12.63
Over Twenty Hours	22	5.67
Total	388	100.00

19. List your curricular load in terms of number of pupils taught, and number of preparations per day, also number of study halls per day.

The chief difference between the rural and the city teachers as reflected in the answers to the question concerning curricular load lay in the number of preparations per day. Whereas the median number of preparations required of county and exempted village teachers was four per day, the city median was two. Nevertheless, there was a considerable group of city teachers having four or more preparations, with some city teachers having as many as six. The median number of study halls was the same for each group, and the median number of pupils per day was in the range from 101 to 125 for each group. The city teachers, however, had a somewhat greater number of pupils, since the median number

for city teachers was close to the upper end of the range.

Data have been presented in Tables CCCXXXIII, CCCXXXIV and CCCXXXV.

TABLE CCCXXXIII

NUMBER OF PUPILS REPORTED PER TEACHER BY 394 CITY TEACHERS OF
SCIENCE IN OHIO

Number of Pupils Per Teacher	Number of Teachers	Per cent of total
0 - 25	2	0.51
26 - 50	14	3.55
51 - 75	26	6.60
76 - 100	61	15.49
101 - 125*	100	25.38
126 - 150	102	25.89
151 - 175	48	12.18
176 - 200	28	7.10
Over 200	13	3.30
Total	394	100.00

*

The median lay close to the upper end of the 101-125 range.

TABLE CCCXXXIV

NUMBER OF PREPARATIONS PER DAY REPORTED BY 388 CITY TEACHERS OF
SCIENCE IN OHIO

Number of Preparations	Number of Teachers	Per cent
One	86	22.17
Two*	151	38.92
Three	91	23.45
Four	38	9.80
Five	15	3.86
Six	7	1.80

*

The median was two preparations per day.

TABLE CCCXXXV

NUMBER OF STUDY HALLS PER DAY REPORTED BY 387 CITY SCIENCE TEACHERS
IN OHIO

Number of Study Halls	Number of Teachers	Per cent
None	162	41.86
One*	159	41.08
Two	59	15.24
Three	5	1.30
Four	2	0.52

*

The median is one study hall. Note that approximately five of every six teachers had one study hall or less.

Summary

In general, the surprising part of this investigation of personal and professional qualities of teachers is the closeness with which much of the information tallies as between groups. In many of the characteristics there seems to be little significant difference as among median teachers in the categories chosen, and in at least some of the cases these differences probably are accounted for when differences in median age and experience have been considered.

By and large the city teachers have had more and longer experiences in related fields outside teaching, they have more hobbies, they belong to more science and science-education organizations, they read more science-and science-related literature, they hold a somewhat greater proportion of positions of leadership in churches, they participate in community drives to a little greater extent, and they feel much more emphatically that they are free to live their own lives. In most other respects the two groups agree rather closely. A resume of the differences which exist would tend to support the thesis that the differences are to considerable extent differences between age groups rather than differences because of being in country or city schools.

Specific summaries follow:

1. Teachers of science as a whole have a considerable degree of experience outside the classroom which is related to their teaching of science. While the city teachers presented a greater variety of types of experience, and longer years of such experience, the difference probably existed because of the age differential.
2. Science teachers as a whole have many science-related hobbies. Photography, collections, gardening, and nature study are important from the standpoint of their selection as hobbies by great numbers of science teachers.
3. Military schools have been credited with adding to the science preparation of many of Ohio's science teachers. Many other teachers have attended various types of schools which were not connected with colleges, teacher training institutions, or universities.
4. Science teachers do not belong to a very great number of science and science-education organizations and associations. While a few do belong to several, the average science teacher belongs to none. Although the membership is limited, a great number of such associations were mentioned by one or more science teachers. City teachers were more likely to belong than rural teachers.
5. Science teachers of Ohio are not great readers of science or science education magazines. A great variety of magazines were listed, but many of them were reported by only a few science teachers. City teachers reported more magazines than did rural teachers.
6. Ohio's teachers of science are outstanding in their community and church leadership. They also exert leadership in youth organizations of the community. Both city and county teachers were found in positions of leadership in great numbers.
7. Teachers of science in Ohio were generally active in membership in fraternal, social, and service organizations of the community.
8. Ohio's science teachers were active in numbers far beyond the average for citizens in general in community and national drives for charitable purposes.
9. Most teachers of science in Ohio believe that teachers in their communities are active in moves for the common good.

10. Most teachers of science in Ohio believed that their communities permitted them to live a normal life in the community. This feeling was considerably stronger among city teachers, (over 90 per cent) than among county and exempted village teachers (over 76 per cent).

11. Almost all science teachers in Ohio had extra-curricular school responsibilities in addition to teaching. This condition was true in cities and in the county and exempted village schools as well.

12. More than two of every five science teachers believed that their extra-curricular work was helpful to them in their teaching. Less than one in five believed such work to be harmful. Many were non-committal.

13. Very few teachers of science believed that their community work hurt their teaching effectiveness. Almost half believed that it was helpful.

14. Just a little more than one-half of Ohio's science teachers are gainfully occupied during the teaching year at any occupation other than their teaching work. Of those who are employed, most work less than eleven hours per week outside of school.

15. The median teaching load for the teachers reporting was between 101 and 125 pupils per day. In the rural schools the number was nearer 101. In the cities it was nearer 125. It must be kept in mind that this figure is somewhat misleading in that many of the sections taught were double-period sections.

16. The science teachers reported a median number of preparations per day which was in all respects the same as the number determined by reference to the records submitted to the state department of education.

17. The median number of study halls per day for the science teachers of the state is one.

CHAPTER IX

TEACHING METHODS USED BY OHIO'S SCIENCE TEACHERS--THEIR EQUIPMENT AND SUPPLIES FOR THE TEACHING OF SCIENCE

INTRODUCTION

Part C of the questionnaire forwarded to all of Ohio's science teachers who were teaching in the public secondary schools of the state dealt with the methods used by the teachers, the physical equipment in their laboratories, expenditures for equipment, use of textbooks, supplementary materials, classroom aids and devices, and with teaching philosophy and objectives. It was designed to cast revealing light on the general practices of the teachers of science in the State of Ohio to the extent that the teachers would admit to taking part in such practices. While the instrument was far from perfect, it was of such nature that it probably reflected somewhat accurately the conditions under which science was being taught by the great number of teachers who responded to it. Even in answering such a revealing question as number 12 in the form (the question concerning the teacher's own estimate of competence in the laboratory and competence in dealing with demonstration equipment) the rather large percentage of teachers answering this question in a way which did not reflect credit upon themselves as teachers of science shows indication of a measure of honesty in completing the questionnaire.

The responses to the questions listed in Form C have been treated as have the responses to Form B in the preceding chapter. Each question has been repeated, then the answers have been given in tabular form together with the required comments. The complete Form C may be found in the Appendix.

In this chapter, because of the rather sharp cleavages as between the smaller and larger schools, the responses from the smaller schools have been placed, item for item, contiguous with the responses from the teachers in the larger schools. Thus a direct comparison may be made within each table of the responses from the two general types of schools.

As in the preceding chapter, county and exempted villages have been combined and form one category. The other category is that represented by the teachers of the city school system. For brevity, tables indicate "county" rather than county and exempted village, but in all cases in this chapter, the two classifications are included under the "county" designation.

Three points may be kept in mind as the following tables are studied. First, is the fallacy of figures. For example, if the great majority of the science teachers of Ohio are indulging in good practices in their teaching, observers may say that a certain situation is, because of these figures, a good situation, yet the fact that even some teachers are not carrying out good practices means that the science education of some of our children is being

crippled. So long as there are any incompetent teachers at all, potential genius is being stifled and mediocrity is being made more mediocre.

The second point to keep in mind is the fact that the average teacher in the city school systems is an older and more experienced teacher than his county-school counterpart. While he has the benefit of added experience, he also has the disadvantage of lack of recency in training. As the tables are studied, these factors of experience and of recency of training may be apparent to the student.

The third point has considerable bearing upon the first. This is the much greater likelihood of the rural teacher of science being a teacher who has neither a major in science training nor a major area in science teaching. The rural teacher of science is very likely to be a home economics teacher, a mathematics teacher, an English teacher with few or no hours of college science and with only a class or two of science tacked to a teaching day spent in a non-related field. Quite a number of questionnaires sent to such teachers of science in the rural schools were returned unanswered with a statement to the effect that the teacher to whom they had been sent lacked knowledge of and interest in the science teaching field and that, therefore, no attempt had been made to answer the questions. While these individuals were, certainly, not teachers of science solely, yet they were the only science

teacher to the students which they had in science and as such were of extreme importance in any study of science teaching conditions and of science teachers.

Not that all such science minors are disinterested and uninformed. Many of the responses exhibiting deep interest in and appreciation of the problems inherent in science teaching came from individuals who either in training, day-by-day schedules or both would be classified as minor teachers of science.

In listing the responses to the questions concerning method, the investigator wishes to insist that no such fragmentation of the teacher can give a picture of the teacher which is completely accurate. The teacher in his summation is likely to be better as a teacher than the summation of the various factors which have been chosen as indicative. No analysis can be a synthesis, but an analysis can be indicative so long as the student realizes that it is just an analysis and as such is limited in its effectiveness. The "intangible factors" which make for good or poor teaching personality, the warmth of feeling, the aptness of expression, the depth of understanding of the master teacher can scarcely be hinted at in a study of this type. However, it is very likely that the teacher who possesses the desirable qualities of personality just listed also will possess a number of other desirable traits including the ability to see the worthwhileness

of certain methods and the desirability of using certain devices, materials, and equipment. The person with a fine teaching personality and the other intangible marks of the master teacher will most likely have a sound teaching purpose. The teacher's response to questions which deal with such items as the preceding sentences indicate will, it is hoped, give some indication with regard to his teaching. In short, no analysis can be a summation, but it can help summarize. No summation can be a totality, but it can help to indicate what the total picture is likely to be.

1. In your teaching, do you make use of movies frequently?
Occasionally? Not at all?

In this question as with others, no attempt was made to define the terms "frequently," "occasionally," and terms of similar vein. Teacher judgment concerning these items was believed a sufficient limitation for the purpose. Neither was there any attempt to specify particular types of movies, etc., since the teacher certainly would not be using movies unless he felt that they had a place in the work of the course or in general educational benefit to the students under his charge.

Responses indicated that percentagewise the city teachers were much more likely to be frequent users of movies and, correspondingly, much less likely not to use movies at all. Three times as many rural teachers as city teachers claimed to use no movies

at all in their teaching. Responses indicated that some of the lack in the county schools was caused by lack of audio-visual equipment. Tabular results follow:

TABLE CCCXXXVI

RELATIVE FREQUENCY OF USE OF EDUCATIONAL MOVIES IN CITY SCHOOLS AND IN COUNTY AND EXEMPTED VILLAGE SCHOOLS AS REPORTED BY SCIENCE TEACHERS

Use of Movies	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Frequently	225	57.84	235	43.12	460	49.25
Occasionally	156	40.10	275	50.46	431	46.15
Never	8	2.06	35	6.42	43	4.60
Total	389	100.00	545	100.00	934	100.00

2. Can you operate a 16-millimeter moving picture projector of the type commonly found in the schools?

As in the preceding question, the percentage of non-operators was much higher in the smaller schools than in the larger ones. Over-all, about one of every nine teachers confessed that they were unable to operate a 16-millimeter movie machine. The inability to operate a machine of this class is not, of course, an insurmountable barrier to a successful educational movie program, since some schools do provide student operators. However, the

proportion of schools providing such operators seemed to be greater in the city schools where the teachers also were more able to operate the machines. While no accurate records were kept, many more city teachers than rural teachers mentioned a student operators' group as being in charge of projection in their schools. Even where such groups exist, it is likely that the teacher who can operate the machines will have fuller use of the equipment at the time which is psychologically right for the use of certain films. Data follow:

TABLE CCCXXXVII

RURAL AND CITY SCIENCE TEACHERS WHO COULD AND WHO COULD NOT OPERATE A COMMON SIXTEEN-MILLIMETER-TYPE SCHOOL MOVIE PROJECTOR

Able to Operate	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Yes	355	91.26	468	85.87	823	88.11
No	34	8.74	77	14.13	111	11.89
Total	389	100.00	545	100.00	934	100.00

3. Can you make minor adjustments and repairs to a moving picture projector?

The science teacher who is able to take care of minor repairs and adjustments to the school movie projector is more likely to approach the whole matter of use of movies with more assurance

than one to whom the projector is a complicated bit of equipment not to be touched.

Response to question 3 indicated that there was little difference between the county and city teachers with respect to the ability of the teachers to take care of minor repairs and adjustments to the school's projectors. An average of approximately three teachers of every four who responded felt that they were sufficiently familiar with the equipment to make minor repairs and adjustments. Tabulations are as follows:

Table CCCXXXVIII

REPORTED ABILITY OF OHIO'S SCIENCE TEACHERS TO MAKE MINOR REPAIRS
AND ADJUSTMENTS TO SCHOOL MOVIE PROJECTORS

Ability to Repair	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Yes	278	72.21	391	71.74	669	72.32
No	107	27.79	149	28.26	256	27.68
Total	385	100.00	540	100.00	925	100.00

4. Do you use filmstrips or filmslides frequently?

Occasionally? Not at all?

Responses to this question indicate that as of the time of this study, filmstrips and slide-films were among the most neglected areas of endeavor so far as multi-sensory aids were concerned. With less than thirty per cent of the teachers using

extensively, it is probable that the majority of science teachers in Ohio did not have sufficient acquaintance with the advantages to be gained in use of these aids. It is probable also that the great majority of these teachers were not aware of the many newer filmstrips which have been placed in use since World War II and which, for many purposes, are better to use than are movies. The smaller, poorer schools should investigate the advantages accruing to the ownership and use of filmstrips, because a small sum of money invested in them will pay rich dividends if they are properly selected and properly used. Almost one teacher of four reporting indicated that they made no use at all of filmstrips or slide-films. Data follow in Table CCCXXXIX.

TABLE CCCXXXIX

USE OF FILM-STRIPS AND SLIDE-FILMS BY 939 OF OHIO'S SCIENCE
TEACHERS

Degree of Use	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Frequently	119	30.59	118	21.45	237	25.24
Occasionally	194	49.87	293	53.27	487	51.86
Never	76	19.54	139	25.28	215	22.90
Total	389	100.00	550	100.00	939	100.00

5. -Can you operate a filmstrip or filmslide projector?

Inability to operate a filmstrip projector does not appear to be the cause for the major portion of the lack of use of filmstrips. With well over ninety per cent of the teachers claiming to be able to use these projectors, only some seventy-seven per cent of the teachers ever made use of them. While probably all science teachers should be able to operate them, there appears to have been here a situation wherein teachers were not using aids whose use they understood, at least so far as the mechanical part was concerned. Data concerning the ability and inability to use filmstrip projectors have been included in Table CCCXL.

TABLE CCCXL

ABILITY AND INABILITY OF OHIO'S SCIENCE TEACHERS TO OPERATE FILM-STRIP AND SLIDEFILM PROJECTORS

Ability to Operate	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Yes	370	95.36	494	92.00	864	93.40
No	18	4.64	43	8.00	61	6.60
Total	388	100.00	537	100.00	925	100.00

6. Can you make home-made slides which are appropriate for use in a science class? Do you ever make and use such slides?

While many teachers interpreted this question in the narrower sense of construction and use of slides for biological purposes only (e. g. microscopic slides) the question implied a wider use of slides than just those having to do with micro-biology. It implied also the use of slides of the type to be used on an overhead projector or for use with a slide projector of any type as well as home-made photographic slides.

A majority of teachers claimed to be able to make such slides, but the minority which proclaims inability to make them is quite large. A majority of science teachers of Ohio who responded claimed that they never did make and use such slides. This proportion goes to more than two of every three county teachers. There are implications in these percentages which have been treated in a succeeding chapter...implications for the teacher training institution as well as for in-service training. The greatest ignorance of process, percentage-wise, and the least use of process occurred among the group which is presumed to have greatest recency of training, the county teachers. Data follow:

TABLE CCCXLI

ABILITY AND INABILITY OF SCIENCE TEACHERS OF OHIO TO MAKE AND
USE HOME-MADE SLIDES HAVING VALUE IN THE TEACHING OF SECONDARY
SCIENCE

Ability to Make and Use	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Yes	267	69.17	300	55.56	567	61.23
No	119	30.83	240	44.44	359	38.77
Total	386	100.00	540	100.00	926	100.00

TABLE CCCXLII

ACTUAL CONSTRUCTION AND USE OF HOME-MADE SLIDES BY 906 OHIO
SECONDARY SCIENCE TEACHERS

Construction and Use	County		City		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Do Make and Use	172	32.70	165	43.42	337	37.20
Do Not Make and Use	354	67.30	215	56.58	569	62.81
Total	526	100.00	380	100.00	906	100.00

7. Can you operate a recording and transcribing device of any type -- disk, tape, wire?

Perhaps reflecting their greater recency of training, the county and exempted village teachers had a somewhat greater percentage of individuals who claimed ability to operate successfully some type or other of recording device. Not in use to any very considerable extent during the pre-war years, disk, wire, and tape recorders have become increasingly common in school situations. Having very considerable possibilities for effective use in science teaching, the indicated ability of somewhat less than two of every three teachers to use these devices may be looked on as a favorable omen; however, all teachers should be able to use them -- then should use the ability. Data have been included in Table CCCXLIII.

TABLE C CCXLIII

ABILITY AND INABILITY OF 912 OHIO SECONDARY SCIENCE TEACHERS TO USE SOME TYPE OF RECORDING AND TRANSCRIBING DEVICE

Ability to Use	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Able to use	234	61.90	352	65.92	586	64.25
Unable to Use	144	38.10	182	34.08	326	35.75
Total	378	100.00	534	100.00	412	100.00

8. Do you use recordings and transcriptions frequently?
Occasionally? Not at all in your teaching?

Recordings and transcriptions appeared to be the least used of any device about which query was made. Only a handful of teachers claimed to use these materials frequently, and by far the majority of science teachers indicated that they never used them. Certainly there are implications in this situation which have been discussed in general in a later chapter. Indications have been given in the preceding table that the great majority of teachers who responded knew how to use recorders and transcribing devices. The fact that they were not using them perhaps indicates that they were not aware of valuable uses for them in their science work, or that they were not certain concerning such uses. To a degree the responses may indicate that the teachers did not have these devices readily available for their use.

TABLE CCCXLIV

USE AND NON-USE OF RECORDINGS AND TRANSCRIPTS BY 931 OHIO
 SECONDARY SCIENCE TEACHERS

Use and Non-use	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Use Frequently	24	6.17	21	3.87	45	4.83
Use Occasionally	125	32.13	128	23.62	253	27.17
Never Use	240	61.70	393	72.51	633	67.00
Total	389	100.00	542	100.00	931	100.00

9. Do you make use of models, live exhibits, dioramas, etc.
in your teaching frequently? Occasionally? Not at all?

While teachers in the county, exempted village, and city schools are all quite likely to use some or all of these devices, the city teachers claimed much greater use of them than did teachers in the other categories. Well over half of the city teachers claimed frequent use of the devices mentioned in question 9, while the percentage was considerably lower for the county and exempted village teachers. Percentage-wise, not quite twice as many county teachers as city teachers claimed no use whatever. In some instances teachers deplored lack of facilities and space for keeping live exhibits. Other teachers deplored the lack of models. A few indicated that they had made their own models. Data follow:

TABLE CCCXLV

FREQUENCY OF USE OF MODELS, LIVE EXHIBITS, DIORAMAS, AND SIMILAR DEVICES BY 932 OHIO SECONDARY SCIENCE TEACHERS

Frequency of Use	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Frequently	221	57.10	212	38.90	433	46.46
Occasionally	151	39.02	298	54.68	449	48.18
Never	15	3.88	35	6.42	50	5.36
Total	387	100.00	545	100.00	932	100.00

10. Do you or members of your class construct models, exhibits, etc. for class use frequently? Occasionally? Not at all?

Both rural and city teachers seem to be almost equally aware of the desirability of class participation and of individual effort in creating devices and materials for educational use. While it was the unusual teacher who reported activity frequently of pupils or of the teacher in this type of creative activity, it was also the rare teacher who reported complete absence of this type of pupil-teacher participation. Even so, too many teachers apparently have not seen the educational advantage of pupil participation in construction experiences. Thus approximately one teacher in eight in all types of schools reporting listed no pupil-performed or teacher-performed activities of this type within the confines of science teaching.

Data have been presented in Table CCCXLVI.

TABLE CCCXLVI

FREQUENCY WITH WHICH 932 SCIENCE TEACHERS OF OHIO CLAIMED THAT THEY AIDED IN OR MADE USE OF STUDENTS IN CONSTRUCTING MODELS, EXHIBITS, ETC. FOR USE IN THEIR SCIENCE CLASSES

Frequency	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Frequently	92	23.65	87	16.02	179	19.21
Occasionally	242	62.21	379	69.80	621	66.63
Never	55	14.14	77	14.18	132	14.16
Total	389	100.00	543	100.00	932	100.00

11. If you or members of your classes wish to carry out experiments or demonstrations for which equipment is not available, do you devise (or aid pupils in devising) such equipment frequently? Occasionally? Not at all?

The percentage of teachers replying that they never devised or aided pupils in devising equipment would be just a little smaller if account were taken of the few who insisted that they had no need ever to devise equipment since their laboratories were so well furnished that all of the equipment that they might need was at hand. However, there were such few individuals, and the analysis of the results as given probably represents a fair picture of the conditions in the state as a whole with regard to using teacher and pupil ingenuity in designing and construction of new equipment for special work. Although the proportion of county and exempted village teachers who claimed not to devise such equipment was slightly larger than the proportion in city schools, the general returns indicated very close agreement among the various categories of schools. Of almost a thousand teachers replying, only 71 claimed never to devise or aid in devising equipment--a hopefully small number. Even the few teachers who claimed excellence and completeness for their laboratories probably could achieve certain goals more readily if they did permit their students to use their ingenuity and inventiveness in developing equipment.

TABLE CCCXLVII

FREQUENCY WITH WHICH 930 SECONDARY SCIENCE TEACHERS OF OHIO DEVISE
OR AID PUPILS IN DEVISING NEEDED SCIENCE LABORATORY OR DEMONSTRATION
EQUIPMENT

Frequency	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Frequently	117	30.23	168	30.94	285	30.65
Occasionally	243	62.79	331	60.96	574	61.72
Never	27	6.98	44	8.10	71	7.63
Total	387	100.00	543	100.00	930	100.00

12. Do you feel competent to work with normal laboratory and demonstration equipment in high school science--thoroughly?
Partially? Do not feel competence in handling such equipment?

While the great majority of the 927 teachers who responded to this question believed that they felt perfectly confident of their laboratory competence, quite a number were not sure of themselves. This number was much higher both in total and percentage-wise in the county schools than in the city. However, in both types of schools there were quite a number of individuals who felt either partially competent or completely incompetent to work in the laboratory, or to work with demonstration equipment. Perhaps the situation may not appear to be too serious, percentage-wise, but it must be borne in mind that even if there were only one teacher in the state who felt incompetent, then somewhere

potential science talent and potential future usefulness, are being wasted. The budding genius is just as likely to be in the class of the incompetent teacher or of the teacher who is unsure of himself as in any other class, all other factors being equal. Not only is it the genius who suffers, but all of the students do who are in contact with this teacher in a situation in which the teacher either is incompetent or feels insecure because of feeling of lack of competency. Implications for teacher education institutions and for boards of education are not hard to draw.

Data concerning question 12 have been tabulated in Table CCCXLVIII.

TABLE CCCXLVIII

BELIEFS OF 927 SECONDARY SCIENCE TEACHERS OF OHIO CONCERNING THEIR OWN COMPETENCY IN HANDLING AND WORKING WITH THE SCIENCE LABORATORY AND DEMONSTRATION EQUIPMENT AVAILABLE IN THEIR SCHOOL SCIENCE ROOMS

Teacher Belief	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Thoroughly Competent	331	85.75	376	69.50	707	76.27
Partially Competent	50	12.95	155	28.65	205	22.11
Incompetent	5	1.30	10	1.85	15	1.62
Total	386	100.00	541	100.00	927	100.00

13. Do you find it advisable to make use of your community for the purpose of taking your classes outside the classrooms frequently? Occasionally? Not at all?

Teachers in the smaller schools as represented by those of the counties and the exempted villages scored better in their use of field trips in science than did the teachers of the city schools. Almost one-fourth of the city teachers claimed never to make use of the field trip in their teaching of science, while only about one in seven of the rural teachers claimed never to make use of such devices.

TABLE CCCXLIX

DEGREE OF USE OF THE FIELD TRIP AS A TEACHING DEVICE BY 929 OHIO SECONDARY SCIENCE TEACHERS

Degree of Use						
	No.	Pct.	No.	Pct.	No.	Pct.
Frequently	59	15.21	78	14.42	137	14.75
Occasionally	237	61.08	385	71.16	622	66.95
Never	92	23.71	78	14.42	170	18.30
Total	388	100.00	541	100.00	929	100.00

14. If the preceding answer is "not at all" why do you not use such trips?

Most teachers who do not use trips had either a plausible answer or an answer which seemed plausible to them. Some biology teachers in rural areas even said that there was nothing of interest in their community! City teachers were more likely to blame their trip-less teaching on their administration than were teachers in the county and exempted village schools. The responses were classified and minor differences ironed out, then were placed in the following categories which differed somewhat as between rural and city teachers.

A. Reasons given by city teachers for not having field trips in science.

<u>REASON</u>	<u>NUMBER</u>
1. Transportation and time difficulties	31
2. Administrative disapproval	14
3. Classes too large	8
4. Trips undertaken by science clubs	2
5. Dangerous to pupils	2
6. Disrupts schedule of the school	10
7. Not adaptable to program	11
8. Disciplinary difficulties	1
9. No advantage	6
10. Personal disinclination	1
11. Insufficient experience	2
12. Community not suitable	1
13. Lack of student interest	1
14. No reason given	2
Total	92

B. Reasons given by county and exempted village teachers for not having field trips in science.

<u>REASON</u>	<u>NUMBER</u>
1. Distance too great to points of value	20
2. Preparation time too limited (too many preparations)	5
3. Nothing of interest in the community	15
4. Classes too large or periods too short	13
5. Do better job in the classroom	2
6. Bring materials into classroom instead	1
7. Possible danger to pupils	1
8. Schedule conflicts or disruption	2
9. No advantage	1
10. Administrative disapproval	9
11. Community disapproval	6
12. No reason	3
Total	78

15. Do you and your students use school or public library materials as source materials for your work in science frequently?
Occasionally? Not at all?

Another one of the questions aimed at breadth of program and use of various types of facilities by teachers, this question met with few complete negations. Of all of the city teachers responding, only three claimed not to use library facilities at all, and of the thirteen rural teachers so responding, most claimed that their schools had such poor libraries that no library work was possible, also that their communities had inadequate public library service. Practically every teacher who commented had something to say concerning the desirability of library work from their point of view. Approximately half claimed frequent library use, the other half occasional library use. Many teachers commented on the need for more adequate libraries in their schools and communities.

TABLE CCCL

USE OF LIBRARIES AS SOURCES OF LEARNING MATERIALS BY 928 SCIENCE
TEACHERS IN OHIO'S SECONDARY SCHOOLS

Frequency of Use	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Frequently	218	56.19	255	47.22	473	50.97
Occasionally	167	43.04	272	50.37	439	47.31
Never	2	0.77	13	2.41	16	1.72
Total	388	100.00	540	100.00	928	100.00

16. Do you use printed or written materials aside from the textbook, laboratory manual, and workbook frequently? Occasionally? Never go beyond these sources of information?

Probably the most interesting point uncovered in the responses to this question was not that so many teachers do use materials other than of the textual type, but that there are some teachers who not only do not use such materials, but actually come to the defense of their program. While only about one and one-half per cent of the teachers claimed never to go beyond the text and the workbook in seeking information for class use, several of the teachers who were in this category believed that going further afield would take away from the value of their work. Their attitude is perhaps best summed up by the teacher who remarked, "There is already so much material in the textbook, so why use anything else?"

While a somewhat higher percentage of city teachers claimed to use outside materials frequently, the percentage not using them at all was approximately the same for all categories of teachers from whom responses were obtained.

Tabulation of data has been made in the following table.

TABLE CCCLI

FREQUENCY OF USE OF PRINTED MATERIALS OTHER THAN THOSE NORMALLY SUPPLIED AS TEXTBOOKS AND WORKBOOKS BY 930 OHIO SECONDARY SCIENCE TEACHERS

Frequency of Use	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Frequently	221	57.25	270	49.72	491	52.85
Occasionally	159	41.19	265	48.80	424	45.64
Never	6	1.56	8	1.48	14	1.51
Total	386	100.00	543	100.00	929	100.00

17. Do you make use of one basic textbook or do you use two or more textbooks regularly as sources of information?

The greatest number of teachers in all categories listed showed preference for only one textbook. Few used two textbooks, but many teachers claimed to use more than two. There was little difference in responses with regard to the size of school represented. The county school teacher was almost as likely to be using more than two textbooks as was the city teacher. He was just a little more likely to be using a single textbook, but the differences between types of schools was not significant at any level of textbook use. Following is the analysis of data from the responses to the preceding question.

TABLE CCCLII

NUMBER OF TEXTBOOKS USED REGULARLY BY 929 OHIO TEACHERS OF
SECONDARY SCIENCE

Number Used	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
One	239	61.76	344	63.47	583	62.76
Two	41	10.60	60	11.07	101	10.90
More than Two	107	27.64	138	25.46	245	26.34

18. Do you bring local materials and other community resources
(including speakers) into your classes frequently? Occasionally?
Not at all?

The great majority of science teachers reported that they did not use local resources of the types mentioned enough to apply the term "frequently" to such use. While many more than half did use them to some extent according to their own statements, there were a very great number who indicated that no use at all was made of such resources. City teachers were more likely to make some use of such resources than were their rural counterparts. However, even in the cities, one teacher of five reported no such use of the community. In the face of recent research tending to indicate that important values may be obtained by bringing the community into the classroom, there appear to be implications in the situation for teacher education and for in-service programs.

Certain teachers insisted that their environments were so poor in resources that nothing was to be gained by using either individuals from the community or by using community materials of other types. Such a possibility seems somewhat remote in view of the findings which have been made and reported in recent years. There certainly are implications for schools which have teachers with such ideas. Community surveys probably would disclose resources which teachers have overlooked and are overlooking.

Table CCCLIII indicates the percentages of use reported by teachers in the city and in the county (and exempted village) schools.

TABLE CCCLIII

DEGREE OF USE OF COMMUNITY RESOURCES BY 928 OHIO SECONDARY SCIENCE TEACHERS

Frequency	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Frequently	59	15.24	49	9.06	108	11.64
Occasionally	251	64.86	340	62.84	591	63.69
Never	77	19.90	152	28.10	229	24.67
Total	387	100.00	541	100.00	928	100.00

19. Are you familiar with the resources for science teachers which are available from the Ohio State Museum and a few other sources such as the State Department of Agriculture?

There probably is need for better dissemination of information concerning the Ohio State Museum and the State Department of Agriculture when between one-third and one-fourth of the science teachers of Ohio claimed not to know anything about the science teaching materials which may be obtained from these organizations. Teachers who know about these materials may consciously choose or reject the teaching aids offered, but if teachers do not know about them they are limiting themselves needlessly. Again, there are strong implications here for teacher-education institutions, also for those who direct in-service programs. If science teachers of Ohio were ill-informed to the extent of one-fourth their number concerning this area of source material, there probably are other areas of equal or greater importance on which they lack information. Some of these further areas have been treated in succeeding questions with much the same results shown in the responses to this question concerning Ohio sources for science teaching materials. Data follow:

TABLE CCCLIV

KNOWLEDGE OF CERTAIN OHIO GOVERNMENTAL SOURCES OF SCIENCE TEACHING AIDS AS LISTED BY 924 OHIO SECONDARY TEACHERS OF SCIENCE

Knowledge of Sources	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Yes	273	71.28	359	66.36	632	68.40
No	110	28.72	182	33.64	292	31.60
Total	383	100.00	541	100.00	924	100.00

20. Do you use state resources such as those mentioned in the preceding question frequently? Occasionally? Not at all?

But a handful of the science teachers reported that they used state sources of the types mentioned frequently. Probably this state of affairs is not too serious of itself, even granted that state sources are of considerable value, since they are not sufficiently diversified to offer assistance in nearly all of the types of work which might be envisioned in science classes. On the other hand, more than two of every five science teachers of the state who reported indicated that they made no use at all of these state sources of materials. Of these, probably a great number did not make any use of them because they did not know about them (see preceding table). There were, however, approximately twelve per cent of the teachers who claimed to know about these sources, but who also claimed that they made no use of them at all.

Following is the analysis of the data concerned with use of state provided sources of materials.

TABLE CCCLV

DEGREE OF USE OR NON-USE OF STATE-SPONSORED TEACHING MATERIALS BY A SAMPLING OF 923 SECONDARY SCIENCE TEACHERS OF OHIO

Frequency of Use	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Frequently	19	4.99	38	7.01	57	6.18
Occasionally	187	49.08	277	51.11	464	50.27
Never	175	45.93	227	41.88	402	43.55
Total	381	100.00	542	100.00	923	100.00

21. Are you familiar with at least two sources of printed tests (standardized or otherwise) in science?

This question was inserted in the questionnaire not with a purpose of determining actual teaching practice, but with the idea in mind that an alert teacher certainly becomes aware of the source material (including tests) in his teaching field. While the great majority of teachers of science in Ohio claimed that they did have knowledge of at least two sources for printed tests, almost one teacher of every five claimed not to know of two such sources. Obviously, if a teacher does not know about tests, he cannot decide whether or not they are useful to him. One somewhat disturbing factor in connection with the responses to this particular question is that the city teachers, who as a group are older and more experienced, had very nearly the same percentage of "no" answers as did the rural group. Data follow:

TABLE CCCLVI

TEACHERS WHO DID AND WHO DID NOT KNOW ABOUT TWO OR MORE SOURCES OF PRINTED TESTS IN SCIENCE (of 853 OHIO SCIENCE TEACHERS REPORTING)

Response	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Yes	267	82.66	429	80.94	696	81.60
No	56	17.34	101	19.06	157	18.40
Total	323	100.00	530	100.00	853	100.00

22. Do you give tests other than those of your own construction frequently? Occasionally? Not at all?

As a companion question to the one preceding, this question evoked responses which might have been predicted somewhat closely from the answers listed for the earlier question. Perhaps it is not surprising that rural teachers, plagued by greater preparation load, had a smaller percentage of teachers who never used non-teacher made tests than did the cities. In the cities, exactly the same percentage did not use non-teacher made tests as claimed not to know of sources for two or more printed tests.

Table CCCLVII indicates the results of the questionnaire as it concerned question 22.

TABLE CCCLVII

FREQUENCY OF USE OF NON-TEACHER PREPARED TESTS AS REPORTED BY 858 OHIO SCIENCE TEACHERS

Frequency of Use	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Frequently	107	33.13	131	24.48	238	27.74
Occasionally	160	49.53	349	65.24	509	59.32
Never	56	17.34	55	10.28	111	12.94
Total	323	100.00	535	100.00	858	100.00

23. Do you use in your teaching, or have you used within the past two years, a resource unit, whether of your own construction or obtained from any source whatsoever? Am now using? Have used such a unit?

In addition to serving as a guide to the number of teachers who had used any type of source unit, this question fulfilled an additional function in that it gave some indication concerning numbers of science teachers who had not kept even reasonably abreast of current educational writing in the field of science education. No one who has made even a cursory examination of the literature of science education at any time in the past several years could have escaped the discussions concerning the resource unit. Yet many, many teachers in answering this question professed complete ignorance concerning the meaning of the term. Perhaps the term is not in common parlance, but it is in very common use in the field of science education, particularly now and in the half dozen years prior to this study. Almost half of the teachers claimed never to have used any type of resource unit. Together with the great number who claimed to use only one textbook (question 17) and the number who claimed not to go beyond the textbook and workbook for information (question 16), certain conclusions have been drawn concerning the probable pattern of science teaching in too many of our Ohio schools. These conclusions have been listed in a succeeding chapter.

TABLE CCCLVIII

DEGREE OF USE OR NON-USE OF RESOURCE UNITS AS REPORTED BY 861
OHIO SECONDARY SCIENCE TEACHERS

Degree of Use	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Now Using	74	22.27	63	11.75	137	15.91
Have Used	112	34.46	189	35.26	301.	34.96
Neither	139	42.77	284	52.99	423	49.13
Total	325	100.00	536	100.00	861	100.00

24. Are you familiar with such listings of free and low-cost materials as the Science Clubs of America Sponsor Handbook, the Peabody Catalog of Free and Low-Cost Materials, or similar listings?

Despite all of the attempts which have been made on a nation-wide scale to acquaint teachers in general and science teachers in particular with listings of free and low-cost materials, less than two teachers of every three who reported knew about such results would not have been surprising, but at the time of this survey, several educational magazines included listings of materials as well as listings of sources. The alert teacher could not fail to see reference to such listings in almost any educational magazine perused, whether the magazine was or was not dedicated to science education. The NEA Journal, School Management, The Instructor, Ohio Schools, are a few general magazines which are widely available to Ohio teachers and which contain frequent

references to such sources as those indicated in the question. Nevertheless the results were as shown in Table CCCLIX.

TABLE CCCLIX

FAMILIARITY OF 857 OHIO SCIENCE TEACHERS WITH SOURCES OF FREE AND LOW-COST TEACHING MATERIALS

Familiarity With	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Yes	218	67.49	331	61.98	549	64.06
No	105	32.51	203	38.02	308	35.94
Total	323	100.00	534	100.00	857	100.00

25. Do you make use of such listings to obtain materials for your classes frequently? Occasionally? Not at all?

This question, a companion to the one preceding, was asked in the hope of determining how many teachers claimed to use such materials; also how many of those who knew about such materials claimed to use them. Percentage-wise, only about ten per cent of those who said that they knew about sources of free and low-cost materials claimed not to use them. Thus there are implications for teacher training institutions and for in-service programs. Approximately 36 per cent of the teachers claimed not to have knowledge of these sources. Approximately 42 per cent claimed not to use them. If the 36 per cent had been informed, there is every likelihood that the 42 per cent would have been much smaller.

The answers given to question 25 have been tabulated in Table CCCLX.

TABLE CCCLX

DEGREE OF USE OR NON-USE OF FREE AND LOW-COST MATERIALS OBTAINED THROUGH STANDARD LISTINGS

Degree of Use	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Frequently	56	17.23	53	9.94	109	12.70
Occasionally	140	43.08	248	46.53	388	45.22
Never	129	39.69	232	43.53	361	42.08
Total	325	100.00	533	100.00	858	100.00

26. Are you familiar with the work of Science Clubs of America? Do your students make any use of the materials prepared by this organization?

In this question, familiarity and use have been placed in the same heading. As might probably be expected, city teachers claimed much greater familiarity, also much greater use of the materials of Science Clubs of America than did their rural counterparts. The number making use of the very helpful materials prepared by this group was discouragingly small, however, among all categories of teachers reporting. Of those who reported, slightly less than one teacher of every four had made use of the materials

listed. In the rural schools the fraction was nearer one in five. Also in the rural schools, only a little over half of the teachers who reported claimed knowledge of the organization listed even though it is the national organization for high school science clubs. The figure for the city schools was more encouraging, but even here some thirty per cent of the teachers claimed not to know about the organization. The responses to the two questions contained in item 26 have been tabulated in Tables CCCLXI and CCCLXII.

TABLE CCCLXI

FAMILIARITY AND LACK OF FAMILIARITY OF 856 OHIO SECONDARY SCIENCE TEACHERS WITH THE WORK OF SCIENCE CLUBS OF AMERICA

Response	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Familiar	227	70.50	286	53.56	513	59.93
Not Familiar	95	29.50	248	46.44	343	40.07
Total	322	100.00	534	100.00	856	100.00

TABLE CCCLXII

USE AND NON-USE OF MATERIALS PREPARED BY SCIENCE CLUBS OF AMERICA AS REPORTED BY 844 OHIO SECONDARY SCIENCE TEACHERS

Response	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Use	98	30.82	111	21.11	209	24.76
Don't Use	220	69.18	415	78.89	635	75.24
Total	318	100.00	526	100.00	844	100.00

27. Are you familiar with the work of the Junior Academy of Science?

Efforts of the representatives of the Junior Academy in Ohio to have their work publicized among science teachers appear to have been only partially successful. Of the 855 teachers who responded to the question, less than half were familiar with the Junior Academy's work. City teachers were much more likely to know about the Academy than were rural teachers, but even in the cities, two teachers of every five confessed that they were not familiar with this organization.

There undoubtedly are implications for teacher-training institutions, for those who direct in-service programs of teacher education, and there are implications for the Junior Academy itself. A few of the teachers who professed ignorance concerning the Academy wrote notes requesting sources of information. One individual complained that he was interested in knowing about such organizations but that he had been unable to obtain addresses or names of individuals to whom inquiry should be addressed.

Results of the analysis of responses have been compiled in Table CCCLXIII.

TABLE CCCLXIII

NUMBER AND PER CENT OF TEACHERS RESPONDING WHO CLAIMED KNOWLEDGE
OF AND NO KNOWLEDGE OF THE WORK OF THE JUNIOR ACADEMY OF SCIENCE

Response	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Yes	190	59.75	223	41.76	413	48.30
No	131	40.25	311	58.24	442	51.70
Total	321	100.00	534	100.00	855	100.00

28. Have you had any student participate in an exhibit sponsored by the Junior Academy within the past two years?

The inspiration of the work of the Junior Academy as represented by participation in its science fairs appears to have been lost on the great majority of science students in our secondary schools. Of the 854 teachers who answered this question, just about one in ten indicated that any of their students had participated in a science fair within the preceding two years. In the rural schools the percentage was only a little over six per cent, whereas the city schools showed a total of about eighteen and a half per cent of the teachers reporting student participation. Certainly, if the values of science fairs are as great as claimed, greater effort should be placed on publicizing the fairs and in inducing teachers to work with students so that

participation may be increased greatly. Table CCCLXIV lists the results reported by 854 Ohio secondary science teachers.

TABLE CCCLXIV

Participation	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Yes	59	18.44	33	6.18	92	10.77
No	261	81.56	501	93.82	762	89.23
Total	320	100.00	534	100.00	854	100.00

29. Do you use government publications such as the Bulletins of the United States Department of Agriculture or of the Bureau of Mines in your teaching, frequently? Occasionally? Not at all?

A relatively small number of teachers reported frequent use of materials of the types listed in this question. A very great number reported occasional use of such materials, but a fairly large group, one-fifth of the total, reported no use at all made of such publications.

Again, city teachers, who already have the advantage of better laboratories, more audio-visual equipment, and larger budgets, reported the greatest use of governmental materials. Since such materials are usually free or low in cost, here is an area which could be explored profitably by the teachers in the smaller and poorer schools. Much of the governmental material

has value for teaching, particularly in the biological and health science areas, and much of it is useful in teaching general science. The expenditure of a small amount of time in locating and obtaining materials from governmental sources would aid the teacher to offer a broader area of work within a given course or subject. Even though the teacher's budget is small, there is no reason for the teacher in the smallest of schools having less than a full complement of useful governmental publications. The fact that of the 535 county teachers reporting, 125 never used such materials indicates a field where breadth could be developed in science teaching in the county and exempted village schools. Not that all city teachers made adequate use of even any use of such materials. By their own admission, 19.2 per cent of the city teachers who reported said that they made no use of these materials. Data follow:

TABLE CCCLXV

FREQUENCY OF USE OF GOVERNMENTAL PUBLICATIONS BY 858 OHIO
SECONDARY SCIENCE TEACHERS

Degree of Use	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Frequently	66	20.43	75	14.02	141	16.43
Occasionally	195	60.37	335	62.62	530	61.77
Never	62	19.20	125	23.36	187	21.80
Total	323	100.00	535	100.00	858	100.00

30. Do you follow the organization of a particular textbook in developing a plan of teaching for your class, always?
Usually? Never?

This question may not have given sufficient latitude in the possibilities for response. Several teachers indicated in their answers that while they did not always or usually follow the organization of a particular textbook, they did sometimes, and so asked that their answer be included in some such fashion. These answers have been, for the most part, placed under a sub-heading termed "Qualified." From the comments made by these and many other teachers, it seems likely that the investigator probably did not include enough choices in leaving space for responses. Nevertheless, the answers have been classified as best might be done, but it should be understood that there probably was a greater number of "individualistic" responses to this question than to most of the others.

TABLE CCCLXVI

EXTENT TO WHICH TEACHERS FOLLOWED THE ORGANIZATION OF A PARTICULAR TEXTBOOK IN DEVELOPING TEACHING PLANS AS REPORTED BY 854 OHIO SECONDARY SCIENCE TEACHERS

Extent	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Always	35	10.83	60	11.30	95	11.12
Usually	236	73.06	428	80.60	664	77.75
Never	39	12.08	41	7.72	80	9.37
Qualified	13	4.03	2	0.38	15	1.76
Total	323	100.00	531	100.00	854	100.00

31. Do you plan the teaching solely, or do the students often or always help in planning the direction of the work?
Teacher plans the work? Both teacher and pupils plan the work?

A much smaller percentage of teachers in the city schools claimed that pupils aided in planning the work than was true with the teachers in the smaller schools. Perhaps this condition is the result of greater tendency toward organization within the larger schools, perhaps it is the result of greater specialization, perhaps the result of the presence of older and less recently trained teachers. Whatever the reason, whereas almost half of the teachers in the smaller schools claimed that they were aided by pupils in planning thw work, only slightly more than one city science teacher in three made the same claim. Even though all of the city teachers who gave qualified answers could be counted as being in the "teacher-pupil-planning" group, the percentage would still fall short of the percentage in the rural group who claimed that the pupils aided.

Many of the teachers expressed the same general fear concerning teacher-pupil planning which was expressed by the administrator who remarked in answering Form A, "Fine for the excellent teacher, otherwise look out!" Results of the question have been listed in Table CCCLXVII.

TABLE CCCLXVII

DEGREE TO WHICH TEACHERS PLANNED THE WORK OF THE SCIENCE COURSE
AND DEGREE TO WHICH STUDENTS AIDED THEM, AS REPORTED BY 859
OHIO SECONDARY SCIENCE TEACHERS

Response	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Teacher	176	54.32	264	49.35	440	51.22
Teacher and Pupils	113	34.88	258	48.22	371	43.19
Qualified	35	10.80	13	2.43	48	5.59
Total	324	100.00	535	100.00	859	100.00

32. In your science classroom and laboratory do you have,
for the most part, the amount and kind of laboratory and demon-
stration equipment and the materials and supplies needed to fulfill
the aims of the course as it is being presented? Yes. Almost.
Equipment and/or materials and supplies somewhat inadequate.
Equipment and/or materials and supplies totally inadequate.

The difference between teaching conditions in the city schools and those in the rural schools can probably be illustrated better by the answers to this question and to the eight succeeding questions than in any other similar portion of the study. While considerably over half of the city teachers gave an unqualified "Yes" answer to this question, only a little over a fifth of the county

and exempted village teachers gave the same response. At the other end of the scale, over fourteen per cent of the rural teachers said that their equipment, etc. was totally inadequate, whereas less than two per cent of the city teachers gave this indication. Another way of giving an analysis of the reports is to state that of the 84 laboratories or classrooms reported as being totally unfit so far as equipment, materials, and supplies were concerned, only seven were in the cities.

Statistics follow in Table CCCLXVIII.

TABLE CCCLXVIII

CONDITION OF LABORATORIES AND SCIENCE ROOMS WITH REGARD TO ADEQUACY OF EQUIPMENT, MATERIALS, AND SUPPLIES, AS REPORTED BY 926 OHIO SECONDARY SCIENCE TEACHERS.

Adequacy	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Adequate	204	53.00	114	21.07	318	34.34
Almost Adequate	89	23.11	148	27.36	237	25.59
Somewhat Inadequate	85	22.08	202	37.34	287	31.00
Totally Inadequate	7	1.81	77	14.23	84	9.07
Total	385	100.00	541	100.00	926	100.00

33. In general is the physical environment in your school, particularly in the science department, good? Fair? Poor?

Answers reported for this question indicated that much the same conditions prevailed in the general physical condition of the schools of the state as had been reported in the preceding question for the condition of the science equipment, materials, and supplies. Doubtless the same financial conditions which cause paucity in one part of the program lead to neglect in the other. Results have been tabulated in Table CCCLXIX.

TABLE CCCLXIX

CONDITION OF PHYSICAL FACILITIES OF OHIO SCHOOLS AS REPORTED BY
925 SECONDARY SCIENCE TEACHERS OF OHIO

Condition	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Good	215	55.84	159	29.45	374	40.43
Fair	146	37.92	263	48.70	409	44.21
Poor	24	6.24	118	21.85	142	15.36
Total	385	100.00	540	100.00	925	100.00

34. Is the laboratory furniture in good? Fair? Or poor condition?

Little difference was discovered between the responses to this question and to the one preceding. Results follow in Table CCCLXX.

TABLE CCCLXX

CONDITION OF LABORATORY FURNITURE IN SCHOOLS AS REPORTED BY 921 OHIO SECONDARY SCIENCE TEACHERS

Condition	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Good	185	48.18	152	28.30	337	36.60
Fair	145	37.76	258	48.05	403	43.76
Poor	54	14.06	127	23.65	181	19.64
Total	384	100.00	537	100.00	921	100.00

35. In general are the instruments, devices, and materials in your laboratory in condition to use or are many of them in need of extensive repair? In condition to use. Many need repair.

In answering this question, it was found necessary to add an additional category in the replies, since quite a number of teachers indicated that they had practically no equipment of any kind. This number was greater in the smaller schools than in the larger schools, but it is significant that in two instances, teachers of science in the cities reported that very little science equipment of any kind was available. This condition certainly could not

be the result entirely of lack of money, since during the years these city schools have had some quantity of money to spend on materials and equipments. It probably was the result rather of lack of administrative interest, lack of administrative confidence in science or in science department personnel, or in lack of direction within the science department itself. Regrettable as it may be that some fifteen of those responding indicated that little of any equipment was available, it is probably more regrettable that in almost half of the county and exempted village schools, equipment was reported as being in poor repair. While teachers of science cannot accomplish miracles in the way of keeping their equipment in trim, yet a glance into all too science rooms shows conditions that are deplorable from a teacher-maintenance standpoint.

A new teacher coming to a poorly maintained science room cannot undo the neglect of decades in a month or so, but progress can be made from month to month, and such progress is watched with interest by most administrators. An analysis of the data concerned with this question has been given in Table CCCLXXI.

TABLE CCCLXI

CONDITION OF EQUIPMENT IN SCIENCE LABORATORIES AS REPORTED BY
917 OHIO SECONDARY SCIENCE TEACHERS

Condition	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Usable	313	8.72	289	54.12	602	65.65
Needs Repair	68	17.75	232	43.45	300	32.72
Little Equipment	2	0.53	13	2.43	15	1.63
Total	383	100.00	534	100.00	917	100.00

36. Approximately how much money per pupil enrolled in your school has been spent in purchasing laboratory equipment and/or supplies during the past two years (do not include expendable items such as chemicals).

While a little over one-third of the number of teachers responding did not answer this question, responses from the remainder indicated that very little money was being spent on science laboratory equipment, materials and non-expendable supplies. Many teachers made rather bitter comments concerning their school situation in answer to this question. Typical was one who indicated that no money had been spent within the past two years, then added, "And not for years, and years, and years."

On the other hand, a few teachers indicated that all of their wants were cared for merely by requisitioning the supplies

and equipment needed. These cases were invariably found in the city systems, with the poorer systems in the rural areas showing the greatest lack of expenditure. It probably would not be fair, however, to lay the blame for lack of expenditure solely to the financial condition of the school. Many schools appeared to have spent either more or less than their general financial condition might lead the student to predict. In some cases this lack of expenditure probably could be laid to lack of interest of the administration, lack of confidence in the science program or the science teacher, or in lack of desire on the part of the science teacher to move forward. Conversely, extra expenditure may have come about as the result of strong administrative interest, strength in the science department, or particularly good leadership on the part of an individual science teacher. Community interest and lack of interest certainly play their part. One community in the state reported a very high expenditure for chemical and physical equipment, influenced at least in part by the presence within the community of a new research laboratory.

Tables of expenditures have been consolidated in Table CCCLXXII.

TABLE CCCLXXII

EXPENDITURES FOR SCIENCE EQUIPMENT REPORTED BY 911 OHIO SECONDARY SCIENCE TEACHERS DURING THE TWO-YEAR PERIOD PRECEDING SURVEY

Amount of Expenditure	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Zero	11	2.97	79	14.60	90	9.88
.01 - 1.00	115	31.08	156	28.84	271	29.75
1.01 - 2.00	35	9.46	50	9.24	85	9.33
2.01 - 3.00	20	5.41	26	4.81	46	5.05
3.01 - 5.00	14	3.79	33	6.10	47	5.16
5.01 - 10.00	10	2.70	16	2.96	26	2.85
10.01 up	11	2.97	24	4.43	35	8.84
No answer	115	41.62	157	29.02	311	34.14
Total	379	100.00	541	100.00	911	100.00

37. Is your room kept well painted? Fairly well painted?
Poorly painted?

Perhaps surprising is the fact that in this question, the responses were almost identical throughout for all classes of schools. In both groups as analyzed in Table CCCLXXIII it may be noted that about 55 per cent said that their rooms were kept well painted, a little over 32 per cent indicated fair paint, and 12 per cent indicated that the rooms were poorly painted. Following are the results:

TABLE CCCLXXIII

CONDITION OF ROOMS WITH REGARD TO PAINT AS REPORTED BY 926 OHIO
SECONDARY SCIENCE TEACHERS

Condition	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Good	212	55.07	298	55.08	510	55.08
Fair	124	32.21	178	32.90	302	32.61
Poor	49	12.72	65	12.02	114	12.31
Total	385	100.00	541	100.00	926	100.00

38. Do you consider that the janitorial service in your science department is adequate? Fairly adequate? POOR?

As in the preceding question, size of school had little to do with adequacy of service. Roughly, the percentages were the same in all classes of schools, and roughly they were the same as in the preceding question. There appeared to be little correlation among the individual returns, however, as regarded the two items. The fact that the percentages of good, fair, and poor were almost the same in the two sets of answers did not indicate that the same schools which had poor paint necessarily also had poor janitorial service. Following are the results:

TABLE CCCLXXIV

ADEQUACY OF JANITORIAL SERVICE AS REPORTED BY 922 OHIO SECONDARY
SCIENCE TEACHERS

Adequacy of Service	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Good	206	53.51	282	52.51	488	52.93
Fair	120	31.17	175	32.59	295	32.00
Poor	59	15.32	80	14.90	139	15.07
Total	385	100.00	537	100.00	922	100.00

39. Are ventilation and heating adequate for the greatest degree of pupil comfort and health? If not always, are they usually satisfactory? Seldom satisfactory?

Again, conditions as reported by the various groups of teachers were roughly comparable, with slightly less of the city teachers claiming good temperature and ventilation conditions, slightly more of the same group indicating that conditions were decidedly unsatisfactory. Results are as shown in Table CCCLXXV which follows:

TABLE CCCLXXVI

VENTILATION AND HEATING CONDITIONS IN SCIENCE ROOMS AS REPORTED BY
923 OHIO SECONDARY SCIENCE TEACHERS

Conditions	City		County		Total	
	No.	Pct.	No.	Pct.	No	Pct.
Good	168	43.52	255	47.48	423	45.83
Usually Good	175	44.82	241	44.88	414	44.85
Poor	45	11.66	41	7.64	86	9.32
Total	386	100.00	537	100.00	923	100.00

40. Is your science room equipped with the proper type of window shades, movie shades, etc. for the best fulfillment of your pupils' needs?

City schools held a definite edge in the responses given to the question concerning window shades, movie shades, etc. Whereas, only one school in three was not properly equipped, if the responses were representative, in the rural and exempted villages the ratio was a little more than one school in two not equipped for the best interests of the students. Following is the tabulation of returns:

TABLE CCCLXXVII

SUITABILITY OF WINDOW SHADES, MOVIE SHADES, ETC. FOR THE PURPOSE OF PRESENTING SCIENCE AS REPORTED BY 921 OHIO SECONDARY SCIENCE TEACHERS

Response	City		County		Total	
	No.	Pct.	No.	Pct.	No.	Pct.
Suitable	250	65.27	263	48.88	513	55.70
Unsuitable	133	34.73	275	51.12	408	44.30
Total	383	100.00	538	100.00	921	100.00

41. In a few words, if you will, please state what your are trying to accomplish in your science teaching.

This question was directed toward the philosophy and objectives of teachers of science in Ohio, and was phrased as it was in order not to call forth an enumeration of textbook platitudes. It was felt that if the question were asked in simple fashion there would be greater likelihood of obtaining answers which might be interpreted realistically. Insofar as this objective was possible to obtain, it is felt that the question was well answered. While the responses did not fit themselves directly into pigeon-holes, almost all of them were susceptible of some sort of classification. Many of the teachers claimed several objectives, some of them almost diametrically opposed. Some were not susceptible of interpretation, and a fairly large number did not attempt an answer. Following are the results of the tabulation.

TABLE CCCLXXVIII

OBJECTIVES OF SCIENCE TEACHERS AS REPORTED BY 926 OHIO SECONDARY
SCIENCE TEACHERS

Objective	Number		
	City	County	Total
None Stated	30	57	87
Transmission of the Heritage	53	55	108
Making Science Functional in Living	134	183	316
Developing Understandings, Attitudes, Appreciations	148	202	350
Meeting Needs of Adolescents	68	63	131
Developing a Broad Fields Approach	2	6	8
Developing Scientific Thinking	88	63	151
Building Better Citizenship	36	14	50
Arousing and Broadening Interests, etc.	77	68	145
Developing Enthusiasm for a Particular Area of Science	26	24	50
Preparation for College	24	24	48
Resolution of Conflict Between Science and Religion	4	3	7
Laying Foundation for Further Scientific Work	41	51	92
Developing Better Human Relations	11	2	13
Meeting Community Needs	8	7	15
Teaching the Course of Study	2	12	14
Following Group Interests	0	1	1
Developing Christian Character	1	0	1

Summary

1. City teachers were much more likely to use movies frequently in their teaching than were county and exempted village teachers. Less than five per cent of the teachers of the state who taught any classes of science claimed to make no use of movies at all.
2. Almost nine of every ten science teachers reported that they could operate the standard 16-millimeter moving picture projector. More county teachers than city teachers reported that they could not operate this device. Many teachers who could not operate the equipment claimed that there was no need for them to learn since student operators cared for the operation of the projectors.
3. More than seven of every ten science teachers claimed that they were able to care for minor adjustments and repairs to moving picture projectors. Great numbers of these teachers apparently care for the audio-visual equipment in their schools. This factor has some importance in thinking about adequate experiences for science teachers in training.
4. Only about one teacher in every four made use of film-strips and slide-films frequently. Another fifty per cent used them occasionally, but almost one teacher of science in every four made no use of these very valuable teaching devices. County teachers made less use of strip-films than did city teachers.
5. Less than seven per cent of Ohio's teachers of science claimed not to be able to operate a film-strip projector. Over 150 of these teachers who claimed to be able to operate a film-strip projector also said that they were using no film-strips.
6. Less than two teachers of every three in Ohio's science teaching program claimed to be able to make home-made slides for use in science classes. Many others claimed to be able to make only microscopic slides. City teachers claimed ability in a much higher percentage than did county teachers.
7. Only a little more than a third of Ohio's science teachers claimed that they ever did make and use home-made slides.
8. Almost two-thirds of Ohio's science teachers said that they were able to use some type of recording and transcribing device. County teachers claimed this ability to a somewhat greater degree than did city teachers. This condition may result from the greater recency of training of the county teachers.

9. Teachers of science in Ohio actually used transcriptions and recordings very little in their work of teaching. Less than five per cent of the teachers claimed to use them frequently, and only a little more than 27 per cent in addition claimed to use them occasionally. City schools appeared to use them more frequently than did county schools.

10. Models, live exhibits, dioramas, etc. were used in rather great number by Ohio's science teachers, if their responses are indicative. Almost half of the teachers, (over 57 per cent in the city schools) claimed that they made extensive use of these devices. Only a little more than five per cent claimed no use whatever.

11. Only one teacher of every seven reported that they did not construct or aid pupils in constructing devices for use in the science program. Some of these justified their position by indicating that their laboratories were well furnished. Others insisted that although they had well furnished laboratories, they believed that the educational experience gained in construction was of importance.

12. Many teachers were frank in admitting that they felt incompetent or only partially competent in handling or working with the science equipment in their own science classrooms and laboratories. While only a little more than one and a half per cent said that they were completely incompetent, more than one science teacher in five felt that he was only partially competent. Not nearly all of these were in county schools, although the proportion was greater in the counties. Even in the cities, more than 14 per cent of the teachers felt incompetent or partially competent in this respect.

13. County teachers were more likely to use the field trip as a teaching device than were city teachers. Many of the reasons giving for not using the field trip were rationalizations rather than reasons. Less than one teacher in five claimed never to use the field trip.

14. The most important single reason in point of number of times mentioned for not having field trips was the matter of transportation and time. "Nothing of interest in the community," and "administrative disapproval" were listed second and third.

15. Almost all of the teachers of science in Ohio used libraries in their teaching according to their report. Less than one per cent of the city teachers reported that they made no use of library materials.

16. Almost all teachers in Ohio reported that they used printed materials other than the textbook and workbook, but only a little more than half reported that they used these materials frequently.

17. Most of Ohio's science teachers were "one textbook" teachers. The percentage was approximately the same in city and county. About one teacher in every four claimed to use more than two textbooks as sources of information.

18. One teacher in every four (one in every five in the cities) said that they never used local speakers or other community resources in their teaching. Less than one in eight claimed to make use of such resources frequently.

19. Almost one-third of Ohio's science teachers said that they were not familiar with the resources for science teaching which are available from state sources such as the Ohio State Museum.

20. More than 43 per cent of Ohio's teachers said they never used state sources of teaching materials in science.

21. More than four science teachers of every five claimed to be familiar with at least two sources of printed science tests.

22. Most Ohio science teachers claimed that they gave tests other than those of their own construction. Only about 13 per cent said that they always used their own tests.

23. Half of Ohio's science teachers have never used a resource unit in their teaching. Even though the rural teachers were more recently prepared, they used resource units to a lesser degree than did their city counterparts.

24. More than one teacher in every three was unfamiliar with any listings of free and low-cost materials for use in the teaching of science.

25. More than 40 per cent of the teachers claimed never to make use of any sources for free and low-cost materials and never to have used such materials in their teaching.

26. Forty per cent of the teachers of science in Ohio were unfamiliar with the work of Science Clubs of America, and more than 75 per cent never make any use of the materials for teaching which are distributed by this group.

27. More than half of the teachers of science claimed that they knew nothing of the work of the Junior Academy of Science, and only a little more than ten per cent of these teachers said that they had participated through their students in one of the Junior Academy fairs within the preceding two years.

28. More than one teacher in every five never used governmental publications of any type in science teaching.

29. Most science teachers of Ohio said that they "usually" followed the organization of a particular textbook in presenting the work of the course. This finding bears out an earlier finding that most of the teachers claimed to be "one textbook" teacher.

30. A greater percentage of county teachers claimed that the pupils worked with them in planning the course than was true for the city teachers. In the state as a whole, slightly more than half of the teachers claimed to do the planning with no assistance from the students.

31. Percentagewise, "adequate" laboratories were more than twice as likely to exist in city schools, according to the judgment of the teachers. More than half of the city laboratories were in this category, with less than two per cent totally inadequate. In the county schools, one laboratory in seven was deemed totally inadequate by teacher standards.

32. The general physical facilities of the school were judged good by two teachers of every five (more than one of every two in the cities). Poor physical conditions existed in six per cent of the city schools, almost 22 per cent of the county schools.

33. Over 36 per cent of the teachers believed their laboratory furniture to be in good condition. About one teacher in five thought that their furnishings were in poor condition.

34. Whereas only about 18 per cent of the city teachers listed the condition of their science laboratory equipment and apparatus as being poor or non-existent, approximately 46 per cent of the county teachers felt this way about their equipment. These figures tend to bear out the conclusions of the state department of education supervisors.

35. Of those responding to the questionnaire, the greatest number of teachers believed that their schools had spent between one cent and one dollar per pupil on permanent equipment during the preceding two years. However, almost four per cent of the schools reported expenditures per pupil in excess of ten dollars in a like time.

36. Most science rooms are kept well painted or reasonably well painted. Only 12 per cent of the teachers responded otherwise. The percentage was almost the same in the county schools and in the city schools.

37. Good janitorial service was the rule in more than half of the schools. Only 15 per cent reported poor janitorial service.

38. Almost ten per cent of the teachers reported poor heating and ventilating conditions in their rooms.

39. Approximately 44 per cent of the teachers said that their rooms were not equipped with shades or were not equipped with shades which were suitable for their science work.

40. Great numbers of science teachers seemed to be without purpose or had very weak purpose in their science teaching. Many objectives as reported seemed to be quite far-fetched and some were quite narrow in intent.

41. Many implications for the teacher education institution and for the designer of in-service programs of teacher education have been given in this summary. Implications exist also for administrators and for boards of education in those items which concern physical facilities and building and equipment conditions. Some implications exist for the teachers themselves.

CHAPTER X

EFFECTIVENESS OF A SAMPLING OF OHIO'S SCIENCE TEACHERS AS JUDGED BY PERSONAL INVESTIGATION

INTRODUCTION

Much time and effort were spent during the period of this investigation in examining the records of secondary science teachers of Ohio with regard to determining evidence concerning the factors of effectiveness which have been mentioned so many times. Masses of data have been presented as a result of the investigations, and it is believed that many of the conditions discovered should be pondered when teacher education institutions survey their training programs, when secondary schools consider their in-service programs, and when communities view the needs of their schools. The facts and figures which have been presented indicate the mass picture, and to a greater or lesser extent, the picture as it existed in the secondary schools in the various classifications with regard to size.

In addition to the factors presented, however, there appear to be certain intangible points which have bearing on the success or failure of a teacher in a given situation. Administrators are familiar with the fact that a teacher who succeeds in one situation may fail in another, and vice versa. At least so far as science teachers are concerned, there seems to be some truth to the old saying that the whole is greater than (or sometimes less than)

the sum of all of the parts. Thus a teacher who seems to be no more than "good" so far as a general rating on the factors previously discussed may be found actually to be an "excellent" teacher because of strength of teaching personality, exceptional ability to accomplish certain kinds of teaching tasks, respect and enthusiasm which he is able to engender in his students, or for a variety of other reasons.

No matter how carefully a set of criteria for effectiveness may be drawn, actual success in teaching sometimes seems to elude our ability to measure. The best that may be said about our factors or effectiveness in their application to Ohio's secondary science teachers is that they are indicative of success or failure, but that in any given situation, success or failure is to a certain extent a will-of-the-wisp, evading our efforts at exact definition or exact measurement.

Certainly we may assume that if the great mass of the teachers of a region are ill-prepared, there will, in general be poor science teaching. We may assume, apparently with much truth, that if a great body of teachers have little or no knowledge of or sympathy for the processes of child development and growth, there probably will be much poor teaching done. We may assume that if the pupils in a great number of schools are on poor terms with their teachers, that in general, these schools will be limited in the value of their efforts toward purposeful education.

Nevertheless, the success or failure of a given teacher appears to depend on so many factors, and on such a variety of combinations of factors, that glaring weaknesses on the part of a given teacher are sometimes overcome completely by strengths which overshadow the deficiencies.

Studying Individual Teachers

In order to judge the actual effectiveness of a number of Ohio's secondary science teachers, the investigator visited a number of schools and worked with quite an extensive number of school principals, teachers, and in a number of instances, pupils and townspeople, while not all teachers were investigated in exactly the same manner, no teacher was included in the listing without a feeling on the part of the investigator that the general picture of his effectiveness or lack of it was clear enough to warrant inclusion.

Teachers were chosen from cities, exempted villages, and county systems. The smallest school which appears in the investigation had a total of six teachers and fifty-six pupils -- the largest school district represented was the largest district in the State of Ohio. Included were teachers representing eight cities, two exempted villages, and nine county schools in eight counties of the state. Forty teachers were studied. Of the forty teachers, eight were considered to be excellent, ten were

judged good, eleven were fair, and eleven were poor. No claim is made concerning the representativeness of the sampling.

Final judgment concerning the placing of the teacher in one of the four brackets of effectiveness (excellent, good, fair, poor) was made by the investigator on the basis of all of the evidence concerning the over-all effectiveness, and not on a basis of the effectiveness which should be demonstrated by totaling and averaging the separate factors. Thus, the method of approach was first to make a determination from all possible sources concerning the over-all effectiveness of the teacher, then to make further investigation concerning the effectiveness in each of the pertinent factors represented in the original inquiry.

In order to accomplish this latter measurement, a check list was used which was completed after reference to as many sources of information as possible including personal observation.

Teachers have been identified only by letter, and have not been arranged alphabetically or by type of school or community in order that identification not be possible. They have not been distinguished by sex, although the two sexes are represented approximately in the proportions in which they teach secondary science in Ohio's schools.

Table CCCLXXIX contains the common information which was obtained and which was applicable throughout to the forty teachers.

The first column of data contains the over-all effectiveness of the teacher as determined by using all possible sources of information. The remaining columns show effectiveness in each factor as determined by using twelve separate factors taken from the original list of seventeen factors. It may be noted particularly that factors seven and nine offer some evidence concerning pupil-teacher, and teacher-supervisor rapport and mutual respect--evidence which the investigator was unable to secure with any degree of accuracy on the very large sampling covered by the data of the preceding chapters.

Following Table CCCLXXIX certain items have been consolidated into case histories which may explain in some cases at least, the rating of final effectiveness of some of the teachers. It was somewhat surprising to this investigator, the number of times the word "discipline" crept into conversations concerning these teachers. Not only did principals use this term often in connection with general effectiveness, it also was much used by pupils, fellow teachers, and townspeople. Perhaps as research educators we overlook the importance which is attached by school people in general and by townspeople to the "discipline" concept. At least three principals or superintendents mentioned discipline as being in their minds one of the most important of all factors in the success or failure of a teacher. Other intimated much the same notion without actually expressing it in so many words.

TABLE CCCLXXIX

GENERAL EFFECTIVENESS AND INDICATION OF FACTOR EFFECTIVENESS OF A
SAMPLING OF OHIO'S SECONDARY SCIENCE TEACHERS

Cases	General Effective- ness	Factors*											
		1	2	3	4	5	6	7	8	9	10	11	12
A	F	G	F	F	P	G	G	F	E	F	E	F	F
B	P	P	P	F	P	P	F	P	G	F	E	P	P
C	E	E	G	E	F	G	G	E	E	E	G	E	E
D	G	G	G	E	F	G	G	G	E	E	G	E	G
E	P	P	P	P	F	P	P	P	G	P	G	P	P
F	E	E	E	E	E	G	E	E	G	E	F	E	G
G	F	G	F	F	F	F	F	F	G	F	G	F	P
H	P	P	P	P	P	P	P	P	G	P	F	P	P
I	P	P	F	F	P	F	P	F	G	F	G	F	P
J	F	F	P	F	G	P	F	F	F	F	E	F	P
K	F	F	F	G	F	F	G	G	F	G	G	G	F
L	G	G	F	G	F	F	G	G	G	G	E	G	G
M	F	G	F	F	F	F	F	G	G	G	G	F	F
N	P	G	P	F	G	P	F	G	F	P	G	F	F
O	G	F	G	G	G	F	G	G	G	E	F	F	F
P	E	G	G	E	G	E	E	E	E	E	F	E	G
Q	G	F	F	F	F	F	G	G	G	E	F	G	F
R	G	P	P	F	P	F	P	P	F	F	F	P	P
S	G	F	G	E	E	G	G	E	F	E	G	G	F
T	G	E	F	G	F	F	G	F	G	G	G	F	F
U	F	G	P	G	P	F	G	G	E	F	G	P	P
V	E	E	E	E	E	E	E	E	E	E	G	E	G
W	F	E	P	F	F	G	G	P	G	P	G	P	P
E	P	F	P	F	G	F	G	P	G	P	G	P	P
Y	E	E	E	E	F	G	E	E	E	E	G	E	E
Z	E	E	G	E	E	E	E	E	G	G	G	E	E

TABLE CCCLXXIX (CONTINUED)

Cases	General Effective- ness	Factors											
		1	2	3	4	5	6	7	8	9	10	11	12
AA	F	F	F	F	E	F	F	E	G	G	G	F	F
BB	E	E	G	E	G	E	E	E	E	E	G	G	E
CC	F	F	F	P	P	F	F	F	P	F	G	F	P
DD	F	F	F	P	P	F	F	G	F	F	G	F	F
EE	P	P	F	P	E	F	F	P	F	F	P	P	P
FF	P	P	P	F	P	F	F	P	F	P	F	P	P
GG	G	G	F	G	F	G	G	G	G	G	G	G	G
HH	G	E	G	G	G	G	E	G	E	E	G	G	G
II	G	E	G	G	G	G	G	G	G	G	G	F	G
JJ	G	E	G	G	F	G	G	F	F	G	G	F	G
KK	E	E	E	E	G	E	E	E	G	E	G	E	E
LL	P	F	F	P	P	P	F	F	F	F	P	P	P
MM	P	P	F	P	G	F	P	F	P	G	P	P	P
NN	G	G	G	F	F	G	G	G	G	E	F	G	G

* Factors 1-12 inclusive have been listed as follows: the numbers on the following list refer to the numbers heading the twelve columns in this table. Letters E, C, F, and P refer to Excellent, Good, Fair, and Poor respectively.

1. Demonstrated breadth and depth of scientific background.
2. Demonstrated functionality of knowledge concerning child development and psychology of learning.
3. Effective use of a sufficient number of teaching methods and techniques.
4. Demonstrated community leadership and normality of life within the community.
5. Consistent philosophy apparent in teaching.
6. Skill in use of aids and devices, teaching materials, etc.
7. Demonstrated pupil-teacher rapport.
8. Primacy of science teaching as the teacher's major interest.

9. Demonstrated rapport and mutual respect between teacher and immediate supervisor.
10. Actual or estimated teacher load in terms of both curricular and co-curricular requirements.
11. Demonstrated degree to which teacher gives a sense of direction to pupils and successfully enlists their aid in planning and conducting the work.
12. Demonstrated effectiveness of the teacher in developing and leading into problem solving situations, in furthering critical thinking, scientific attitudes, and appreciations.

Factor Effectiveness

Factor effectiveness of the forty teachers whose cases were considered in Table CCCLXXIX have been considered in the following tables.

TABLE CCCLXXX

FACTOR EFFECTIVENESS OF TEACHERS WHOSE OVER-ALL EFFECTIVENESS
WAS RATED AS "EXCELLENT"

Factors	Number of Cases			
	Excellent	Good	Fair	Poor
1	7	1	0	0
2	4	4	0	0
3	8	0	0	0
4	3	3	2	0
5	5	3	0	0
6	7	1	0	0
7	8	0	0	0
8	5	3	0	0
9	7	1	0	0
10	0	6	2	0
11	7	1	0	0
12	5	3	0	0

TABLE CCCLXXXI

FACTOR EFFECTIVENESS OF TEACHERS WHOSE OVER-ALL EFFECTIVENESS WAS
RATED AS "GOOD"

Factors	Number of Cases			
	Excellent	Good	Fair	Poor
1	3	4	3	0
2	0	7	3	0
3	2	6	2	0
4	1	3	6	0
5	0	7	3	0
6	1	9	0	0
7	1	8	1	0
8	2	6	2	0
9	6	4	0	0
10	1	6	3	0
11	1	6	3	0
12	0	7	3	0

TABLE CCCLXXXII

FACTOR EFFECTIVENESS OF TEACHERS WHOSE OVER-ALL EFFECTIVE WAS
RATED AS "FAIR"

Factors	Number of Cases			
	Excellent	Good	Fair	Poor
1	2	4	5	0
2	0	0	8	3
3	0	3	6	2
4	1	1	5	4
5	0	2	8	1
6	0	5	6	0
7	1	4	5	1
8	2	5	3	1
9	0	4	6	1
10	2	9	0	0
11	0	1	8	2
12	0	0	6	5

TABLE CCCLXXXIII

FACTOR EFFECTIVENESS OF TEACHERS WHOSE OVER-ALL EFFECTIVENESS WAS
RATED AS "POOR"

Factors	Number of Cases			
	Excellent	Good	Fair	Poor
1	0	1	2	8
2	0	0	4	7
3	0	0	6	5
4	1	3	1	6
5	0	0	6	5
6	0	1	5	5
7	0	1	3	7
8	0	5	5	1
9	0	1	5	5
10	1	4	3	3
11	0	0	2	9
12	0	0	1	10

Examination of the preceding tables will show that for this sampling there seems to be considerable relationship between the individual factor effectiveness and the over-all effectiveness, with the exception of the situations described by factors four and ten. In these two factors, there appears to have been but little relationship between the rating as given for the two factors and the over-all effectiveness rating of the teachers. Whether this situation is general, and whether or not the factors are themselves of little or of negative importance in defining effective teaching is left to later research to determine. The results of this small sampling at least casts a doubt upon the authenticity of these "factors" as really having much bearing on the situation. While in general, teacher responses to the general questionnaire indicated that they "felt" that a heavy teaching load decreased their effectiveness, the fact remains that in this small sampling, teachers with light teaching loads seemed to be no more effective in general than those with more unfavorable teaching loads. The reader should note, however, that the small size of the sampling, and the fact that the sampling probably is not representative casts a considerable doubt upon any generalization that might be attempted. The same situation is evident in the application of factor four which has to do with normality of life in the community and with community leadership.

Case Studies

Case A. A rather broad picture was obtained with regard to this teacher. This is a case of a teacher who could have been "good" or even "excellent" except for certain unfortunate mannerisms and for a lack of sympathy and understanding. This teacher maintains excellent formal discipline, but there is in evidence the attitude "Here it is if you want it; if you don't, don't bother me."

Case B. This teacher has little knowledge beyond the textbook and is not willing to exert the effort to develop a well-rounded picture of the area of work, of child development, or even of the place of the school in the community. A teacher who does not engender respect in the students.

Case C. An alert teacher who has won considerable notice in just a few years of teaching. Considerable evidence was at hand to indicate that this teacher is improving and is working hard toward mastery of the professional side of the work.

Case D. With somewhat less evidence than in the preceding cases, there seems to be enough evidence to show a hard-working teacher who lacks the brilliance and fire ever to be more than a good (but never an excellent) teacher. This teacher is developing better pupil-teacher rapport, and should improve somewhat through hard work.

Case E. A teacher who is weak in most areas of the work. This teacher does not have the respect of the pupils nor of the fellow-teachers or supervisor. This teacher's chief difficulty seems to

be aimlessness and weakness. There is little preparation in evidence, the course is bookish and uninviting, apparatus, supplies, and equipment are in poor condition and in disarray. This teacher is not improving.

Case F. Despite the fact that this teacher does more of the planning for the pupils than some educators would approve, and despite that fact that the teacher was working under the handicap of a rather poor physical surroundings, this teacher was one of the outstanding teachers in over-all effectiveness. Pupil-teacher and teacher-supervisor rapport was outstanding. This teacher is alert for new developments and constantly strives for general improvement as well as for new scientific knowledge.

Case G. A "fair" teacher who could be "good" if less self-centeredness were in evidence. This teacher has greater depth of knowledge in one scientific field than breadth over the area of the high school sciences. Despite depth of knowledge, there is evidence of neglect of equipment and lack of use of the proper equipment. There appeared to be little scientific work in progress except for the use of the textbook.

Case H. A harsh, rasping voice which is in evidence all of the time, very poor relations with students, fellow-teachers, and the supervisor marked this teacher. There was little evidence of much scientific knowledge. There was no evidence that the use of equipment and apparatus was attempted except when the teacher

was being visited. Students were unruly and townspeople were rather caustic in criticism. Students were permitted to mishandle equipment which was in evidence. This person had very little interest in teaching.

Case I. This individual has little interest in the sciences, being a "weak minor" in the science area. Although interest ~~is~~ frequently expressed by this teacher, little attempt ever has been made to go beyond the talking stage. Lack of ability makes it unlikely that this teacher will improve to any great extent.

Case J. This teacher lacks sympathy which would lead to greater success in teaching. This lack of sympathy extends to relations with fellow teachers and thus handicaps the whole program somewhat. Greater emotional poise would increase the effectiveness of this teacher.

Case K. A teacher who has improved greatly. Not trained primarily as a science teacher, and having a school interest area outside the sciences, this teacher nevertheless has developed, according to a considerable body of evidence, from a "poor" to a "fair" teacher. With greater inspiration, could become a good teacher.

Case L. A reasonably "good" teacher who, according to the rather considerable amount of evidence, is just a little too lazy to be an "excellent" teacher. Even though the rating is good, this teacher does have some difficulty with certain types of students,

and is not always reasonable.

Case M. A "fair" teacher who could be "good." This teacher does not have a higher rating chiefly because of outside interests and because of a lack of desire to succeed in the teaching of science. This teacher does not organize the work and tie it together in a fashion to make it as meaningful as it should be to the students. Neither does he organize the students or aid them in organizing themselves to the best advantage.

Case N. This teacher has many of the qualities associated with teachers who rank considerably better in general effectiveness. A purposelessness marks much of the work, and the classes are likely to be "gossipy" rather than informative and developmental.

Case O. A good example of the stodgy, plugging type of teacher who is never on fire, but usually arrives sooner or later. This teacher, for all of the lack of apparent drive, maintains good relations with the pupils and with other teachers. Perhaps the outstanding quality of this teacher is helpfulness. Students know that they will be helped--perhaps not in an exciting way, but they never will be denied and they will never meet with sarcasm.

Case P. This teacher overcomes a several minor faults by intense desire and hard work. Located in a situation which wants much in the way of equipment and desirability of physical surroundings, this teacher has by sheer hard work and a willingness to enter into the lives of the students and of the other teachers, become a fine teacher who is still developing.

Case Q. This teacher would be regarded only as "fair" except for the fact that he has greater ingenuity in devising teaching situations and the equipment to enter into them than has the average teacher. With only a fair knowledge of the subject, with only a fair understanding of students, and with only fair command of accepted techniques, this teacher has developed teaching situations which have interested, intrigued, and instructed the students. This teacher is handicapped by a relatively shallow background of science.

Case R. This teacher apparently has little knowledge of the subject and little interest in it. Not trained in science, circumstances have forced this individual to teach one of the sciences. There is little justification for any hope that the students are benefiting to any extent from the work.

Case S. This teacher does not have a very deep background of science, but does have much human warmth and sympathy, and is quite dynamic in presenting the work. Without the genuine interest and desire which are engendered by this approach, this teacher could not rank higher than "fair." Because of these factors, and because of an eagerness on the part of the teacher that the students shall succeed, many of these students catch fire and surpass their teacher.

Case T. Mannerisms make this potentially "good" teacher only "fair." Abruptness, poor diction, poor speaking voice, and annoying habits add to the difficulties of this teacher.

Case U. This teacher could be a much better teacher except for two factors. Self-centeredness causes poor relations with students, with other teachers, and with the supervisor. A feeling apparent on the teacher's part that a person with his preparation has "arrived" and need not keep abreast of current happenings in the world of science and in the world of teaching has caused a steady deterioration of the work.

Case V. This teacher might be only "good" if it were not for the excellent public relations engendered by the type of program presented. A strong interest in anything new, together with wide use of valuable techniques in teaching cause this teacher to be recognized both by the pupils and the townspeople as having work which is of value. This teacher is mentioned immediately when anyone in this school is asked concerning the outstanding teacher of the school.

Case W. A teacher who has an excellent background of work in science, but who has very little understanding of people. This individual should have been a research scientist, not a teacher.

Case X. This teacher does not inspire enough respect even from the first ever to set up a learning situation. The class never becomes organized, and pandemonium reigns.

Case Y. A truly inspired teacher. This teacher always has his students with him and he is with them. His class is a succession of living experiences with living things. He is keenly alert,

interested, informed, and his spirit is contagious. He is a master teacher.

Case Z. This teacher is another master teacher who achieves much the same results as Teacher Y but achieves them in an entirely different way. Quieter, less forceful in personality, this teacher wins students' confidence somewhat more slowly, but once having won them, guides them so expertly that they emerge with more than a knowledge of science and a scientific way of thinking and living -- they emerge with a love of the work and with appreciation for themselves and for other people.

Case AA. A "fair" teacher who lacks the basic knowledge of the scientific areas. Inclined to be somewhat slipshod in preparation, this teacher probably will not improve. This teacher has a very strong outgoing personality which causes him to be quite popular with students.

Case BB. An excellent teacher who achieves excellence partly by exercise of strong personality. Somewhat formal in approach, this teacher overcomes weaknesses which might thereby develop through sheer mastery of the tools of learning. A little more "humanness" would help this teacher to be even better.

Case CC. A teacher who could be good with the proper interest and attention devoted to teaching. Outside interests detract greatly from effectiveness.

Case DD. A teacher who intrudes personal problems into teaching to the extent that certain desirable qualities are hidden.

Case EE. Only partially prepared in science, this individual has other interests and gives the science little time or attention. The students displayed no more interest than the teacher.

Case FF. This young teacher divided loyalty between two areas of endeavor. Unsympathetic with students, not very understanding in approach, this teacher probably will improve little if at all. While this teacher had what might be called good formal discipline, it seemed to be discipline without a purpose other than maintenance of police order.

Case GG, HH, II, JJ, and KK seemed to have nothing to mark them particularly. All except one were "good" teachers, but not outstanding teachers. The one who was outstanding appeared to achieve this rating by very hard work and by being an exceptionally understanding person.

Case LL. A "poor" teacher who probably will improve. This teacher was in a situation which would be discouraging even to many good teachers. With proper supervision, and with proper desire on this teacher's part, improvement could be rapid.

Case MM. A poorly grounded teacher who seems not to desire to improve. Outside interests probably preclude the idea of better teaching in the future.

Case NN. An unusually sensitive and sensible teacher who suffers from a physical handicap which makes complete effectiveness difficult to achieve. This teacher may and probably will improve somewhat through the years.

Summary

Results of this study show that at least so far as this sampling was concerned, it was not possible completely to predict the over-all effectiveness or ineffectiveness of an individual teacher from his effectiveness in each of a series of effectiveness factors. Personality differences, varying conditions under which the individual was teaching, compatibility with the totality of the situation, all appear to have their effects. Certain teachers have been studied who were more effective and certain have been found who were less effective than their average point rating would indicate.

There seems to be nothing in this portion of the study, however, which negates the general idea that factor effectiveness is indicative of general effectiveness. A survey of Tables CCCLXXX-CCCLXXXIII shows that in general and for the average teacher designated, factor effectiveness as determined by averaging the factors studies is not too far from over-all effectiveness as judged by all possible means.

Thus, while judging the effectiveness of an individual teacher by reference to a group of factors might be dangerous in the extreme, there appears to be no evidence presented herewith which would make it invalid as a procedure to be used in determining over-all effectiveness of a large group of teachers.

Since there is less evidence in other phases of this study concerning pupil-teacher rapport, and since this portion of the study made direct inquiry into this phase of teacher effectiveness, one point may be of interest. In the forty cases studied, pupil-teacher rapport differed in rating from general effectiveness in twelve cases. In only two cases was this difference more than one step. In both of these cases there appeared to be personality factors which

influenced the ratings. In one case, a rollicking personality caused the teacher to be highly regarded for personal qualities by the students, in the other, a gossipy and over-familiar attitude causes the over-all effectiveness of the teacher to be reduced.

Generally, poor pupil-teacher rapport appeared to come as the result of definite teacher weaknesses which were apparent to pupil, supervisor, visitor, and even to townspeople. In several instances supervisors indicated that attempts had been made by them to aid the teacher overcome the personality quirk. In some instances the poor relations appeared to grow from lack of ability, lack of knowledge, and lack of understanding on the part of the teachers.

The parallel between student-teacher and teacher-supervisor rapport is not complete, but in general, teachers who worked well with students also maintained good relations and an attitude of mutual respect between themselves and their supervisors. Although no thorough study was made of a third point, their relations with townspeople, there was enough evidence in this respect to indicate that these relations roughly paralleled the others.

Perhaps more needs to be said about factor two and its relationship to general effectiveness. A study of Tables CCCLXXIX and CCCLXXII shows that several teachers who were rated as "excellent" in over-all effectiveness were rated as no better than "good" in functional knowledge of child development and the psychology of learning.

There are implications in this condition for teacher-education institutions. Although earlier portions of this study have shown that with many teachers there are pitiable weaknesses in subject matter competence, this particular condition denotes that there probably are just as serious weaknesses in the preparation of teachers for understanding of the child. This "forty-teacher study" furnishes the only evidence presented in this investigation concerning the adequacy of the professional education of teachers. Chapter five furnished some evidence concerning the number of semester hours of pedagogical subjects which were on the transcripts, but did not give any indication regarding the suitability of this work. It probably is true that even today the number of hours of schooling in professional educational subjects gives a lesser clue to educational understanding than is true for other subjects. The individual who presents a number of hours of "education" may have yet had few experiences which enable him to understand the growth of the child, the problems of adolescence, and the processes of learning.

It is hoped that this study will direct attention to the lack of competence in subject matter which has been found among teachers, particularly teachers in the smaller schools. It is hoped also that needed attention may be given to the inadequacies discovered in the field of understanding adolescents as people and as learners, and in the field of understanding the processes of learning.

CHAPTER XI

INTERPRETATION OF THE FACTORS OF EFFECTIVENESS AS APPLIED TO SECONDARY-SCHOOL SCIENCE TEACHING

The preceding chapters have presented the problem of this study, have indicated the methods used in determining a set of factors of effectiveness to be validated and investigated, and have presented both the method of investigation and the results of the investigation. In this chapter, an effort has been made to relate conditions in Ohio as they have been discovered in the state-wide study to the factors of effectiveness in science teaching. The preceding chapter has offered evidence which indicates that a summation of factors of effectiveness may not always be a reliable indication of overall effectiveness of the individual teacher, but that so far as the small sampling of teachers was concerned, such a summation is at least indicative of the probable effectiveness of teachers on a broad base. In an individual case, a summation or an averaging of scores made in each of the individual factors might be of little importance, however such procedure appears to have value of at least an indicative nature on a state-wide base.

Thus if, state-wide, a study disclosed that teachers had great gaps in their scientific preparation, if it disclosed little understanding by teachers of the growth and development

of children and of the psychology of learning, certainly much poor teaching would be a concomitant. On the other hand, if the antithesis of this situation existed among a great body of teachers, one could expect with confidence that other factors would be, in the main, such that the general level of teaching would be much higher, all physical factors remaining the same.

Reformers of teacher education curricula have proceeded on the basis of one kind of evidence or another, and sometimes, one suspects, on very little evidence of any kind except the evidence of general impressions. If it is granted that teacher-education institutions have constant need to re-survey their offerings, certain knowledge should be made available to those who consider any proposed changes. They need to know precisely the conditions which exist with regard to teaching and learning. They need to have evidence to indicate how well prepared or how poorly prepared are those who are teaching in the schools today. They need to have some evidence regarding the physical conditions under which these teachers will be working. They need rather specific evidence concerning the teaching load, the type of extra-curricular activities to be cared for--in short they need a picture of the educational scene into which their trainees will be injected.

It is hoped that the data which have been presented as well as the interpretations which have been made will be of value to those who prepare teachers in that they do furnish a recent picture of conditions which existed among science teachers and among the schools. It is hoped that the conditions depicted are those which really have significance, and are pertinent to the effectiveness of the teaching and learning situation.

It is hoped that the data presented will have not only an effect upon those who prepare teachers, but also on the teachers themselves, upon the administrators and supervisors who work with the teachers, and upon boards of education and communities which must assist in developing good physical situations in which the teachers may work. It is hoped that these boards of education and community representatives will see the desirability of supplying needed equipment, supplies, materials, and space so that the education of secondary youth not be handicapped.

Purpose of This Chapter

This chapter presents an interpretation of data on the basis of the relationship of the data to the factors of effectiveness. Thus in each case an attempt has been made to answer the question, "What evidence exists in this study to indicate that

conditions in Ohio in secondary science teaching were good, fair, or poor with relation to the factors of effectiveness?" In no case has a complete answer been given, but in all cases, sufficient data have been collected to give indicative results.

There is no portion of this study which may be thought of as complete. It is indicative rather than exhaustive. Another student might take any individual portion of this study and pursue it much farther than this study has proceeded.

Summary of Data

Before turning to an attempt at interpretation of the data in the light of the factors of effectiveness, the salient points of the data have been summarized as follows:

1. In Ohio, there were five and two thirds men teaching science for every woman teacher in the field. This figure varied from one woman to every seven and one third men in the exempted villages to one woman for every four and seven tenths men in the cities. The rural schools were more nearly like the exempted village schools in this respect. Thus science was more likely to be taught by a man in the smaller schools than in the larger, although men predominate everywhere.

2. In the county schools, women were more likely than men to be teaching science without a degree (about two and a half

times as likely), although the percentage in both cases is quite small. Men in the county schools were more than twice as likely on a percentage basis to have their master's degree. The number of doctorates among county science teachers was insignificant.

3. All teachers in the exempted villages who were teaching any science at all had degrees. Men were a little more than twice as likely to have a master's degree. There were no teachers with doctoral degrees.

4. In the cities, the men were a little more likely to have a master's degree. The number of doctorates was not significant.

5. The city teacher was much more likely to have a master's degree than either the county or exempted village teacher. The figure was 49.4% for city teachers, 30.9% for exempted village teachers, and 21.83% for county teachers. These differentials existed in spite of the fact that a very great portion of the county science teachers were men principals who were more likely than regular teachers to have a master's degree.

6. Slightly more than two thirds of Ohio's teachers had the bachelor's degree, slightly less than one third the master's. About one percent had no degree at all. The number with a doctoral degree was not significant.

7. County teachers were, by and large, much more recently prepared than were city teachers. In this respect, the exempted

village teachers were much more nearly like county teachers than like city teachers. A teacher in a rural school was more than three times more likely to be a beginner than was one in the city schools. Also, city teachers were likely to have received their degrees prior to 1920 almost ten times as frequently as county teachers. County teachers thus represented a much younger and more recently educated group of teachers.

8. More than one teacher in every seven in the county schools had no experience prior to the year of the study. About one in every three and a half had one year or less. Less than two in every three had more than two years' experience. Percentages in the exempted village schools were somewhat lower, and in the cities only about one in fifteen had one year or less of experience, with less than one in 33 being a new teacher.

9. About one fourth of Ohio's science teachers received their most recent degree within the two years preceding the study.

10. Over one tenth of Ohio's science teachers were beginning teachers. About one fifth had one year experience or less, and about three of ten had three years or less.

11. The most recently trained group of teachers in Ohio from the stand-point of most recent degree was the group of county-school men teachers, with median degree date in 1946. The least recently trained group was the group of city women, with median degree date in the 1930-34 span.

12. About one percent of county teachers (and exempted village teachers) and about ten percent of city teachers had no degree awarded since 1920.

13. The median number of years taught was in the six to ten-year bracket for both men and women in the county and exempted village schools, and in the 21- to 25-year bracket for city men teachers, and the 26- to 30-year bracket for city women teachers of science.

14. Eighty-five county teachers were teaching science subjects in high school with no college training of any kind in any science. Over one of every three such teachers (551 of 1470) had twenty-five semester hours or less total training in all kinds of science. These county teachers were more often than the city teachers required to teach a number of sciences.

15. About one of every thirteen county teachers was teaching with no preparation at all in his major field of science teaching (110 of 1470). Over half had thirty semester hours or less in their major area of science teaching.

16. Twenty-nine of 324 county teachers whose major area of science teaching was biology offered no biology credit.

17. Five teachers of 81 in the county schools whose major area of science teaching was chemistry offered no chemistry credit.

18. Twenty-five of 185 teachers whose major area of teaching was physics (in the county schools) offered no physics credit.

19. About one science teacher in every six in the county schools offered 20 semester hours or less of professional educational credit. Over one half offered 30 hours or less.

20. About one of every 20 exempted village teachers offered no credit at all in science. About one in every three and a half offered 25 semester hours or less.

21. Fifteen of 207 exempted village teachers, or about one in 14 offered no training at all in their major area of science teaching. Forty-eight, or about one in four offered 15 semester hours or less.

22. Seven of 70, or one of every ten exempted village teachers whose major area of science teaching was biology offered no credit in this subject.

23. No exempted village teacher whose major area of science teaching was chemistry offered less than six semester hours in this subject, but three of thirty-one offered from six to ten hours.

24. One of 29 physics teachers (teachers whose major science area is physics) in the exempted village schools offered no physics credit. Only two, however, offered less than ten hours.

25. Two of 207 exempted village teachers offered no professional educational credit. Eighteen, or less than one in

ten offered 20 hours or less. More than half had 31 or more hours.

26. In Ohio's city schools, 43 teachers of 864, or about one teacher in 20 presented no credit at all in any science subjects.

27. A little less than one teacher in every four in the city schools had 25 hours or less of total science credit.

28. In the city schools, 54 teachers of 864, or one in 16 had no science preparation in the field of their major area of science teaching. Somewhat less than half had 30 semester hours or less the field of their major area of science teaching (363 of 864).

29. In the city schools, 17 of 299 teachers whose major science area was biology had no biology credit, with 43 of 299 having had 15 hours or less. Thus one in 17 had no credit, and about one in seven had a rather limited amount of credit.

30. In chemistry, nine of 152 city teachers whose major area of science teaching was in chemistry had no chemistry credit at all. Twenty-three had 15 hours or less.

31. In physics in the city schools, five teachers of 98 whose major area of science teaching was in this field, had no physics credit. Twenty-five of 98, or about one fourth of the teachers had 15 hours or less.

32. About one tenth (80 of 864) of the city teachers had 20 hours or less of professional educational credit.

33. A total of 139 teachers in Ohio were teaching scientific subjects with no college credit in any science. In addition there were 140 teachers who may or may not have had any science since their records were so incomplete as not to permit judgment. These figures are based on a total of 2541 teachers.

34. Of the 2541 teachers, 179, or one in 14 had no preparation in his major area of science teaching.

35. Of all teachers, 389 or 26.46% in the county schools; 47, or 22.70% in the exempted village schools, and 208, or 24.07% in the city schools had preparation in only one science. These numbers are in addition to those who had no preparation in any science at all. Thus about one teacher of science in Ohio out of every three either had no science at all or had preparation in only one science area.

36. Preparation of the county teachers who taught general science differed little from that of other science teachers.

37. In the county schools, 186 of 558 teachers who taught general science offered no biological science at all.

38. About one in three (178 of 558) county teachers teaching general science offered no physical science.

39. Scarcely any county teachers of general science offered any hours of earth science.

40. About one general science teacher in every eight in the county schools offered any college work in general science (70 of 558).

41. In the county schools, the smaller schools were more likely to have poor science rooms. In the county schools, one science room was rated excellent, 32 superior, 385 satisfactory, 288 fair, and 94 poor. Thus almost half ranked lower than satisfactory. In some schools science rooms were non-existent. These were chiefly the smallest schools.

42. In exempted villages, conditions were better than in the county schools, but there were three poor science rooms and thirteen fair, or almost one in every five rating less than satisfactory.

43. In the cities, 28 of 257, or a little over one in ten science rooms was rated less than satisfactory.

44. In the matter of certain items of standard equipment, county schools ranged from three percent not having running water to almost eighty percent not having germinating beds, with the median lack for the list of standard equipment standing at 32 percent. Exempted villages ranged from zero percent not having three of the most common items to 55 percent not having germinating beds for a median for all items of 18.52 percent. The city schools ranged from a low of 0.72 percent on two common items to a high of 32.70 percent on germinating beds. The city median stood at 7.40 percent. Thus in the matter of certain items of standard equipment, city schools were in far better condition than either of the other two types of schools on most items,

and exempted villages were in much better case than county schools.

45. Some 24 county schools of 509 possessed nothing that could be distinguished as a science room.

46. Of the 1062 schools whose records were examined, 233 cases were found in which the local school executive or principal was teaching one or more classes of science. All of these were in the county groups except 19 which were exempted village schools.

47. Of 815 county schools, 291 had only one person teaching science. In many of these the one person was the principal. In many others it was the coach.

48. Teachers in Ohio's smallest group of county high schools (enrollments 1-25 per grade), were required to teach a very wide variety of science and non-science subjects, with 60 percent of the teachers having five or more separate preparations per day. This percentage dropped as the size of the school increased, so that the average county high school teacher of science had four preparations per day or less, however, over 30 percent of all county teachers had six, seven, or even eight preparations per day. In the exempted villages, the median preparation load was three, but a little more than one teacher in 20 had five or more preparations. The median number of preparations in Ohio's city high schools was two, but some had as

many as seven preparations. A negligible percentage had more than four, however. The average number of classes taught per day was about five in all classes of schools. It should be remembered that many of these were double-period classes (or seven-period-per-week classes).

49. Science was taught much more frequently (on a percentage basis) by science majors in the city schools than in the county schools. By "science major" is meant an individual who spent the greatest portion of his school day teaching science.

50. Of Ohio's smallest high schools, 34 of 372 four-year and senior high schools, or almost one in ten offered the science only. Additionally, 164 offered only two sciences (at a time). When only one science was given it was more likely to be general science. When two were given, they were more likely to be general science and physics. In some cases in these two-science high schools, physics and chemistry were alternated. When three were given, they were more than two and one half times as likely to be general science, biology, and physics as any other combination. Many of these small high schools never offer chemistry because of complete lack of chemical supplies, equipment, and facilities for performing experiments or even creditable demonstrations.

51. In the medium-sized county high schools, only four of 329 offered one science only. This was general science in

all four cases. The percentage of schools offering three or four sciences was proportionately greater than in the smaller schools. General science, biology, and physics (as a combination) was about twice as likely to be offered as any other group.

52. Conservation was offered by five of the smaller county high schools and coal mining science was offered by three of the medium-sized county high schools. Conservation was offered also by three of the larger county high schools and coal mining science by one of them.

53. All exempted villages offered more than one science. All but one offered more than two.

54. All city high schools except one offered more than two sciences. All but 26 offered more than three.

55. Thirty-nine different sciences were offered in Ohio in addition to the standard four high school sciences. Some of these courses were offered by only one high school, others seemed to be regional in nature. Senior science, for example, was found more extensively in the Cleveland area, botany in the Cincinnati area, conservation in Trumbull county, and coal mining science in Jefferson county. Of these subjects, senior science had the greatest number of devotees (91) with physiology next (35), Aeronautics (16) and botany (14) were next in order.

56. Only one county and exempted village teacher of every six had no significant outside work experience, while the median teacher had more than one type of outside experience, with about one in six having had at least three general types. In the city schools, most teachers had significant work experience outside teaching, with about one in eight having had no such experience. About one in every four presented more than two general types of work experience which was considered significant for science teaching.

57. Teachers in Ohio's county and exempted village schools have had, in general, rather significant experiences outside school from a standpoint of time spent in various types of work which relate to the teaching of science. The median teacher had two or more years of such experience. The median city teacher had three or more years of such experience.

58. The county teachers, by and large, had science-related hobbies, although one out of three (165 of 538) claimed no such hobby. Most of those who had hobbies have spent an appreciable length of time in developing the hobby. City teachers were more hobby-minded than were the county teachers, with only one of every six not claiming a hobby which was science-related. They also claimed a longer period of hobby development.

59. Most county and exempted village teachers claimed no particular organized educational experiences aside from their

formal schooling (357 of 560). The others claimed widely varying types of science-related educational experiences. Again, the city teachers were in slightly better case with 221 of 412 claiming no such experiences.

60. Less than one in five of the county and exempted village teachers belonged to any science or science-education associations or groups. Of those who did belong, more (36) belonged to the National Science Teachers Association than to any other group. In the cities, one teacher of every two and one third claimed membership in some such organization. Here the most common type of organization was the district or state science group with a membership of 87 teachers. However, 52 of these teachers claimed NSTA membership.

61. Fifteen percent of the county and exempted village teachers claimed never to read any science or science-education magazines. An additional 12 percent claimed only occasional reading. More than three of every five of these teachers claimed not to have read any science or science-education books during the preceding two years, aside from secondary textbooks. Of the magazines read by county teachers, the "popular science" type was the most widely listed. Of the city teachers, eight percent claimed not to have read any such magazines, and 47 percent listed no books. The city teachers were more likely to list magazines of the Scientific American, Science News Letter type than were

the county teachers.

62. Of the 545 teachers in the county and exempted villages who answered the question relating to further education of any type, 377 indicated nothing beyond their formal schooling. Of the remainder, more (42) listed travel than any other single item. Approximately half of the city teachers listed additional educational experiences, with travel again leading the list.

63. Somewhat less than half of the county and exempted village teachers (43 percent) held or recently had held positions of leadership in their church. More than 60 percent of these had held the positions for more than a year. Almost half of the city teachers (49 percent) held such positions, and more than half of these had held their positions for five years or more.

64. Over half (53 percent) of the county and exempted village teachers were participating or had recently participated in out-of-school youth activities in a position of leadership. The percentage among city teachers was about the same.

65. About two thirds of Ohio's county and exempted village science teachers reported membership in one or more fraternal, social, or service organizations in their community. The percentage in the cities was a little less.

66. About 40 percent of Ohio's rural and exempted village science teachers reported leadership in community drives in the

recent past. The percentage in the cities was slightly higher, about 44 percent.

67. About 72 percent of rural and county teachers believed that teachers in their communities often assumed leadership in moves for the good of the community. In the cities the figure was about 80 percent.

68. About three of every four county and exempted village teachers reporting believed that their communities permitted them to lead a normal life. For the cities, the percentage was somewhat over 90 percent.

69. Only 23 of 558 county and exempted village teachers of science had no extra-curricular school duties. For 227 of these teachers, or more than a third, coaching was all or a part of the extra duty, while with 108, administration or supervision entered the picture in addition to other extra-class duties. In the cities, 18 of 411 teachers did not have extra duties. There were 92 coaches, 220 who had clubs of one type or another, and 40 who were administrators or supervisors.

70. About one in five county and exempted village teachers reporting believed that their extra-curricular load hurt their teaching. About two in five believed that it helped. The rest either had no opinion or believed that it didn't matter. In the cities, one in eight believed that the extra-curricular load was harmful, and again, two in five believed that it was helpful.

71. Only about one teacher in 20 in the county and exempted village schools, and one in 50 in the city schools, believed that his community work load was harmful to his teaching. Almost half in each case believed that it was harmful to his teaching. Almost half in each case believed that it was helpful. The rest either didn't know or qualified their answers.

72. In county schools, exempted villages and cities, about half of the teachers reported that they did no extra-contractual work for pay during school months. In all three categories about one teacher in five reported working more than 11 hours per week for pay outside school hours.

73. The median Ohio teacher of science had a pupil load, aside from study halls, of from 101 to 125 pupils per day. The county teachers were near the lower end of this range, the city teachers near the upper end. It is well to remember that these figures included only total number of pupils faced and did not include the fact that many of the classes were double-period sections.

74. The median preparation load reported by county teachers was four per day. This tallies with the load as recorded from state department of education data. The number of study halls was one per day. The median number of preparations reported per day by city teachers was two, which also tallies with state department figures. Also with city teachers, the median number of study halls was one per day.

75. Half of the state's teachers reported that they used movies frequently in their teaching, with about one in 20 reporting no use, the rest occasional use. The percentage of users was reported to be somewhat larger in the city.

76. Over nine of every ten city teachers, and about 84 percent of the county and exempted village teachers reported that they could operate a standard 16-millimeter movie projector.

77. About seven of every ten teachers in both county and city reported that they could make minor repairs and adjustments to a movie projector.

78. Filmstrips and slide-films were used frequently as teaching devices by only one teacher in four. About half of the teachers reported occasional use, the rest reported no use at all. The percentage of frequent users was larger in the cities, of non-users was larger in the county and exempted village schools.

79. Almost all of Ohio's teachers of science claimed to be able to operate a filmstrip projector. Only one in 20 of the city teachers, and one in 12 of the county teachers claimed not to be able to do so.

80. Seven of every ten city teachers and somewhat over half of the county and exempted teachers of science claimed that they actually could make home-made slides which have value in teaching secondary science.

81. A little less than a third of the county and exempted village science teachers, and a little more than two in five city teachers of science claimed that they actually did make and use home-made slides in their science teaching.

82. About three of five city teachers, and about two of three of the county and exempted village teachers claimed that they were able to use some kind of recording and transcribing device.

83. Only a small percentage of teachers, (six percent in the city and less than four percent in the rest of the schools) claimed that they used recordings or transcriptions frequently in their teaching. A majority of the teachers (60 percent in the city and over 70 percent in the county and exempted village schools) claimed never to use such teaching devices.

84. Almost three of every five city teachers claimed to make frequent use of models, exhibits, dioramas, etc., as compared with about two of every five in the smaller schools. About four percent of the city teachers never used such devices as compared with about six percent of the rural teachers who claimed never to use them.

85. Less than one of every four city teachers of science, and less than one of every six county and exempted village teachers frequently made use of pupil assistance in setting up models,

exhibits, etc., according to their claims. On the other hand, a larger percentage of county teachers (69.80 percent as compared with 62.21 percent) claimed occasional use of such student help. Almost the same percentages in each case (about 14 percent claimed that they never used students for this purpose.

86. In both rural and city schools, approximately three of ten teachers said that they regularly either devised or aided pupils to devise needed laboratory and demonstration equipment which was not available. About six in ten said they did so occasionally, and less than one in ten said not at all. In a minority of these last cases the teacher inserted the comment that his laboratory was so well furnished that there never was need to devise equipment.

87. About 85 percent of the city teachers and 70 percent of the county teachers said that they felt thoroughly competent in their science laboratories. About 13 percent of the city and almost 29 percent of the county and exempted village teachers said they felt only partially competent, while something less than two percent of the teachers in each case said that they felt totally incompetent in their science situation.

88. About 15 percent of all of the teachers claimed that they made frequent use of field trips. About 61 percent of the city teachers and about 71 percent of those from the smaller schools claimed to make occasional use, with approximately one fourth of

the city teachers and 14 percent of the others claiming that they made no use at all of field trips. Administrative objection or administrative difficulty was one of the leading causes mentioned by city teachers. Distance to points of interest was a leading cause advanced by others.

89. About 56 percent of the city teachers and 47 percent of the rest claimed that they made frequent use of libraries in their science teaching. A negligible number of city teachers and two and one half percent of other teachers claimed no use of libraries at all.

90. About 57 percent of city teachers and half of the county and exempted village teachers reported frequent use of printed materials other than textbooks and workbooks. Only about one and a half percent in each case reported no use of such additional printed materials.

91. Somewhat over 60 percent in each case were one-text-book teachers according to their report, a little over ten percent said that they used two texts, while a little over one in four reported using three or more textbooks.

92. Community resources were used frequently by over 15 percent of the city teachers and a little less than one in ten of the other teachers according to their statements. About one fifth of the city teachers and nearly 30 percent of the other teachers claimed never to draw community materials into their science teaching.

93. Over 71 percent of the city teachers and about two of every three county and exempted village teachers claimed that they were familiar with the state's sources for supplementary teaching materials in science.

94. Only about five percent of the city teachers, and seven percent of the county and exempted village teachers (many of them primarily agriculture teachers) claimed frequent use of state-prepared materials for teaching science. About half of the teachers of the state in both classes claimed to use them occasionally.

95. About four of every five teachers in city, county, and exempted villages claimed to be familiar with two or more sources of printed tests in their science fields.

96. About one third of the city teachers and about one fourth of the other teachers claimed to make frequent use of tests other than those of their own construction. About half of the city teachers and two thirds of the county teachers claimed to use them occasionally, with 17 percent of the city teachers and ten percent of the others claiming never to use them.

97. About 22 percent of the city teachers, and half that percentage of the other teachers claimed to be currently using a resource unit of one type or another. About 35 percent in each case claimed to have used one within the past two years. Thus about 42 percent of the city and 53 percent of the other

teachers said they never had used one. From the attached comments, many teachers had never heard the term used and had no idea concerning what was being queried.

98. About two thirds of the city teachers, and a little over three fifths of the other teachers claimed familiarity with sources of free and low-cost teaching aids in science.

99. About 17 percent of city and ten percent of the other teachers claimed to make frequent use of listings of free and low-cost materials. Approximately 43 percent of the city and 46 percent of the other teachers claimed occasional use. Thus two out of five city teachers and a little more than that number of other teachers claimed no use of sources of free and low-cost science teaching aids at all.

100. Approximately seven of ten city teachers and just a little over half of the other teachers claimed familiarity with the work of the Science Clubs of America.

101. Only three of every ten city science teachers, and two of ten of the other teachers claimed to make any use whatever of the teaching and club materials prepared by the Science Clubs of America.

102. About 60 percent of the city teachers, and slightly over 40 percent of the other teachers claimed to have any knowledge about the work of the Junior Academy of Science.

103. About 18 percent of the city teachers, and six percent of the others claimed to have had any students participate in a junior academy fair during the preceding two years.

104. Approximately one of five city teachers of science, and one of seven of the others claimed to make frequent use of government publications which are of use to science teachers. Approximately 60 percent in each class claimed to make some use of these materials.

105. Approximately 11 percent of the teachers in both groups claimed that they always followed the organization of a particular textbook in developing their teaching plans. Approximately 73 percent of the city and 80 percent of the other teachers said that they usually did, with about 12 percent of the city teachers and eight percent of the other teachers saying that they never followed such organization.

106. Over half of the city teachers and almost half of the others said that they alone planned the work of the course in all cases. Approximately 35 percent of the city teachers and over 48 percent of the other teachers claimed that the students helped, while almost 11 percent of the city teachers wished to make qualified answers which, for the most part, stated in rather general terms that some slight help was permitted but that the teacher set the direction of the course.

107. More than half of the city teachers, but only about one of every five teachers in the smaller schools believed that their science rooms were adequate. Less than two percent of the city teachers, but over 14 percent of the county and exempted village teachers believed that their science rooms were totally inadequate.

108. While the city teachers reported the physical facilities in their schools to be good in 56 percent of the cases, less than 30 percent of the county and exempted village teachers so reported. Only a little over six percent in the cities believed their physical facilities to be in poor condition, while in the other schools the percentage was almost 22 percent.

109. In approximately half of the city schools the laboratory furniture was reported to be in good condition, with 14 percent reporting "poor." In the smaller schools, the "good" percentage was a little over 28 percent, and the "poor" was almost 24 percent.

110. In a little more than four reports of every five, science equipment in city schools was reported as being in generally usable condition, whereas in the other schools the percentage was 54 percent. Additionally, whereas a negligible number of city teachers reported very little equipment available, approximately two and one half percent of the county and exempted villages reported this condition.

111. Whereas a little less than three percent of the city teachers reporting indicated that there had been no science expenditures in their schools during the preceding two years, almost 15 percent of the county and exempted village teachers submitted such a report. While a great many teachers did not answer this question, or pled ignorance regarding the amounts spent, in both city and county schools the median amount spent was in the range from one cent to one dollar per pupils for the preceding two-year period.

112. In all groups of schools, about 55 percent reported that their rooms were well painted, about one of three said fairly well painted, and the remaining 12 percent indicated that their rooms were poorly painted.

113. Janitorial services were rated good by slightly more than half of the teachers, city and country alike, fair by about 32 percent, and poor by about 15 percent.

114. Conditions of heating and ventilation were reported good by about 46 percent of the teachers in all brackets, usually good by about 45 percent and poor by some nine percent.

115. Rooms were reported equipped with proper shades for good use of the room in carrying out the work of a science class or laboratory by approximately two thirds of the city teachers reporting, and by less than half of those reporting from the other schools (49 percent).

116. Not more than half of the objectives of science teaching as reported by science teachers showed very great insight into or grasp of any recognizable broad philosophy for education of youth in a democracy. Many of the statements, given as sole responses to the question included somewhat limited objectives as, for instance, "preparation for college," or "teaching the course of study."

117. "Factor of effectiveness" seems, in broad general terms, to be rather indicative of overall effectiveness.

118. Particular strengths or weaknesses in any one or more of the somewhat "intangible" factors such as pupil-teacher rapport, may overcome contrary ratings on other "tangible" factors.

119. Non-suitability to teaching, much of which could have been detected during any extensive guidance program in the teacher-training institution seems at the root of much poor compatibility as between teachers and pupils on the one hand, and teachers and supervisors on the other.

120. In the sampling of forty teachers, teachers seemed to be succeeding quite well who were overloaded, but there is no evidence but that they would have done better with less load. Teachers also seemed to be successful, if most other aspects were favorable, when they were taking no particular leadership in their community aside from their work in school.

Interpretation of Data and Application to
the Factors of Effectiveness

Data which have been presented, chiefly in tabular form, in earlier chapters of this report have been summarized in the preceding pages of this chapter. The chief purpose of this chapter, however, has been to interpret the data in the light of the factors of effectiveness which were investigated and which were reported in detail in Chapter IV. Not only were the data to be interpreted, but they were to be applied to the factors of effectiveness so that conclusions may be drawn relative to the program of science education in the public secondary schools of the State of Ohio.

The plan of this portion of the chapter has been to state the factors in order, and to develop for each factor the evidence which has been uncovered by the various means used to determine evidence throughout this investigation. The factors and the applications follow:

Factor 1

Other factors being equal, effective learning is more likely to occur when the teacher has a broad background of knowledge in the particular science he is teaching as well as in the related science areas.

Some evidence relating to Factor 1 is direct, other evidence is indirect. The various types of evidence have been presented as follows:

- (1) Of 2541 teachers of science in Ohio, 139 teachers had

no post-secondary science credit of any kind. Of these, 85 were county teachers, 11 were exempted village teachers, and 43 were from the city schools. An additional 40 teachers had no preparation in the science which they were teaching as a major science teaching field. The median preparation of science teachers in Ohio in terms of semester hours of all sciences was in the range from 26 to 50 semester hours. The median number of hours of preparation in the major area of science teaching for the science teachers of Ohio was slightly more than 30 semester hours. (Tables LXIII and LXIV, Chapter V)

(2) Of 2541 science teachers, in addition to the 139 who had no post-secondary science preparation, 644 had preparation in only one type of science. (Table LXIX, Chapter V)

(3) General science teachers in the county schools (individuals who taught one or more classes of general science) were poorly prepared in the physical sciences, in the biological sciences, and almost completely unprepared in the earth sciences on the basis of post-secondary credit. (Tables LXX, LXXI, LXXII, LXXIII, LXXIV, LXXV, Chapter V)

(4) Teachers in the county schools who were teaching one or more classes of chemistry, biology, or physics, appeared to be little better prepared from a stand-point of semester hours of science credit than were general science teachers. They were somewhat more likely, however, to have preparation which held significance for the particular subject which they were

teaching. (Tables LXXVI - LXXXII, Chapter V)

(5) In Ohio's smallest county schools, there were many more individuals teaching science who were teaching it during a minor portion of their teaching day than otherwise. (Table CVIII, Chapter VII). This percentage of "science minors" drops to somewhat less than half in the next larger schools, then drops rapidly for the largest county schools, the exempted village schools, and the city schools. (Table CXXVII, Chapter VII).

(6) Less than one percent of the teachers of science in Ohio's secondary schools had no degree. More than 66 percent had a bachelor's degree, and almost 32 percent had at least a master's degree. A negligible number offered doctorates. (Tables XX, XXI, XXII, XXXVI, Chapter V). City teachers were more than twice as likely as county teachers to have a master's degree, and more than one and one half times as likely as exempted village teachers to have this degree. Almost half of the city teachers had their master's degree.

(7) Teachers in the county schools were much younger and more recently prepared than were teachers in the city schools. (Tables XXIX, XXX, XXXI, XXXII, XXXIII, XXXIV, XLII, XLIV, Chapter V)

(8) Of 538 county and exempted village teachers reporting, all but 90 had significant experience outside their school experience. (Table CCLXXXV, Chapter VIII) Of the city teachers, all but 47 of 390 had such experience. More than half of both

groups had two or more such types of experience. The average teacher had more than two years of outside experience which was significant for science teaching. (Tables CCLXXXVII, CCCXI, and CCCXIII, Chapter VIII.)

(9) Of 538 county and exempted village science teachers, 373 had science-related hobbies. Of 404 city teachers, 340 had such hobbies. (Tables CCLXXXVIII and CCCXIV, Chapter VIII.)

(10) Of the county and exempted village teachers, 207 of 560 reported additional science-related schooling beyond their formal college work. In the cities the figure was 191 of 412. Much of this work was taken while the teacher was in the Armed Services. County teachers presented a greater amount of service-connected schooling than did city teachers. (Tables CCLXXXIX and CCCXV, Chapter VIII.)

(11) Travel was the most important added factor of educational experience presented by both city and county teachers. (Tables CCXCIV and CCCXX, Chapter VIII.)

(12) In the "forty-teacher study" in all cases but one, "excellent" teachers had "excellent" subject-matter background. In this case the background was rated as "good." (Table CCCLXXX, Chapter X.)

(13) Of ten "good" teachers, three were listed as excellent, four as good, and three as fair in subject-matter background. (Table CCCLXXXI, Chapter X.)

(14) Of 11 "fair" teachers, two were listed as excellent, four were good, and five were fair in subject-matter background. (Table CCCLXXXII, Chapter X.)

(15) Of 11 "poor" teachers, one was rated as good, two fair, and eight were ranked poor in subject-matter knowledge. (Table CCCLXXXIII, Chapter X.)

Conclusions Concerning Factor 1

There is considerable evidence in the preceding summary to the effect that:

(1) Poor preparation in science is almost the rule among teachers in the smaller county schools, and is present in considerable force even among the teachers in the larger city schools. The situation is serious at all points, but is particularly acute with respect to the teaching of general science, which appears in the smaller schools to be taught by almost anyone regardless of preparation.

(2) Recency of preparation seems no guarantee that the teacher will have better subject-matter preparation. Most of the more recently prepared teachers are in the county schools, but there is no evidence to show that they are in any way better prepared from a credit-hour standpoint than are the older teachers in the county schools. They appear to be much more poorly prepared in terms of semester hours of science than are the older teachers of science in the city schools.

(3) Science teachers, by and large, have added considerably to their science preparation through very extensive out-of-school science-related occupational duties, through science-related hobbies, and through additional schooling beyond the type which usually is given in the teacher-preparatory institution. In this last type of preparation, county teachers appear to lead city teachers, probably because of the many science-related schools of the Armed Services.

(4) Science teachers in Ohio appeared to be in better situation with regard to post-secondary schooling and advanced schooling than they were at the time of the Ferguson study three years earlier.

(5) Most science teachers who were rated as "excellent" also were declared excellent in their command of the subject-matter of science, and in descending order, the overall rating of effectiveness was quite close to the rating given to effectiveness in the subject-matter of science.

Factor 2

Other factors being equal, effective learning is more likely to occur when the teacher has a functional knowledge of how children develop and how learning takes place.

Most of the direct evidence concerning the functional knowledge of teachers concerning child development and the principles of learning came from the "forty-teacher study." Other evidence was so indirect as to be suspect, but it has been included for

the sake of completeness. The findings have been included as follows:

(1) In no case did any teacher who was rated as "excellent" rate lower than "good" in this factor of understanding. (Table CCCLXXX, Chapter X.) Of ten teachers who rated as "good" seven also rated good in understanding and three rated as fair. (Table CCCLXXXI, Chapter X.) Of the 11 who were classed as fair teachers, eight were rated as fair in understanding, and three were believed poor. (Table CCCLXXXII, Chapter X.) Of the 11 poor teachers, four rated as fair in functional understanding and seven were rated poor. (Table CCCLXXXIII, Chapter X.)

(2) Only eight teachers of science in Ohio had no professional educational courses, but 346 had 20 or less semester hours in the field, and 854 more had from 21 to 30 hours. The rural teachers presented somewhat fewer semester hours in this area than did the city teachers. (Table LXVIII, Chapter V.)

(3) Teachers in Ohio's county schools were much younger and much more recently prepared than were the teachers in the city schools. (Tables XXIII-XXVIII, Chapter V and Tables XXXI-XXXIV, also XLII and XLIV, Chapter V.)

Conclusions Concerning Factor 2

Such evidence as exists in this study concerning factor 2 as it applies to Ohio's schools indicates that:

(1) "Excellence" of understanding of child growth and

development, and of the nature of the learning process is a factor which should receive considerable attention due to the fact that it appears to have been neglected. Evidence for this statement comes from the "forty-teacher study" wherein only four teachers of the forty ranked as "excellent."

(2) The great majority of teachers in the city schools were prepared prior to the recognition of the need for knowing about and for developing teacher competency in understanding of child development. They also were trained in a by-gone psychology of learning, and as has been shown, indirectly, have not put themselves in position to have their earlier teaching challenged. In this respect, the only evidence which exists (recency of preparation) points toward some advantage on the part of the county schools.

(3) Further evidence concerning competency in understanding child development comes from the total number of semester hours of professional educational credit. It is certain that in most cases the first fifteen to eighteen hours of such work comprises the requirements as released by the state department of education. With this number of hours subtracted from the total offered by the median teacher, there is little left which could possibly have been devoted to a study of child development.

Thus while much of the evidence is somewhat indirect and negative, there are grounds for belief that the preparation of

science teachers in Ohio has been neglected with respect to the competency envisaged in factor 2. A state-wide weakness is believed to exist in this area

Factor 3

Other factors being equal, effective learning is more likely to occur if the teacher knows about, understands, and uses functionally, a variety of methods of instruction as opposed to the exclusive use of one or two methods.

(1) With respect to the use of movies in teaching, approximately half of the teachers of science of the state report frequent educational use. Almost half report occasional use, while five percent report no use made of these aids. City teachers were somewhat more likely to use movies than were county and exempted village teachers. (Summary to Chapter IX.)

(2) Nine of every ten teachers of science reported that they could operate a moving picture projector of the standard 16-millimeter type, and more than seven of every ten reported that they could make minor repairs and adjustments to them. (Summary, Chapter IX.)

(3) Only about one teacher in every four made frequent use of filmstrips or slide-films in teaching science. About the same number made no use of them. (Summary, Chapter IX.) Largely this was not due to the fact that the teachers could not operate filmstrip projectors, as only seven percent pleaded ignorance of ability to operate them.

(4) While two of every three science teachers said that they could make home-made slides for use with their science classes, only a few more than one of every three actually were making and using them. (Summary, Chapter IX.)

(5) Whereas two thirds of the science teachers said that they could use a recorder-transcriber of some type, less than one third actually used such a device in their teaching. (Summary, Chapter IX.)

(6) Almost half of the science teachers claimed to use models, exhibits, dioramas, etc. extensively in their teaching. The percentage was greater in the cities. Only about five percent claimed to make no use of them. (Summary, Chapter IX.)

(7) Only one teacher of every seven reported that they did not construct or aid pupils in constructing devices for use in the science program. (Summary, Chapter IX.)

(8) County teachers were more likely to use the field trip as a teaching device than were city teachers. Less than one teacher in five reported never using the field trip. (Summary, Chapter IX.)

(9) Almost all of the teachers of Ohio reported that they made some use of libraries in their science teaching. (Summary, Chapter IX.)

(10) Almost all teachers in Ohio reported that they used printed materials other than the textbook and workbook, but only

a few more than half reported frequent use of these materials.

(Summary, Chapter IX.)

(11) Most of Ohio's science teachers, by their own admission, were "one text-book" teachers. Approximately one teacher in every four claimed to use more than two textbooks.

(Summary, Chapter IX.)

(12) One teacher in every four (one in five in the cities) said that they never used local speakers or other community resources in their teaching. (Summary, Chapter IX.)

(13) Half of Ohio's science teachers have never used a resource unit in their teaching. Even though rural teachers were more recently prepared, they reported less use of this device than did the teachers in the city schools. (Summary, Chapter IX.)

(14) Most of Ohio's science teachers said that they regularly or usually followed the organization of a particular textbook in presenting the work of the course. (Summary, Chapter IX.)

(15) In the forty-teacher study, in no case did an excellent teacher rank lower than excellent on this item concerned with use of variety of methods. (Table CCCLXXX, Chapter X.)

(16) Of ten good teachers, two ranked excellent, six were good, and two were fair on this factor. (Table CCCLXXXI, Chapter IX.)

(17) Of eleven fair teachers, three were rated as good, six were fair, and two were poor on this item which concerns competence

in methods of instruction. (Table CCCLXXXII, Chapter X.)

(18) Of 11 poor teachers, six ranked fair, and five were poor on this factor. (Table CCCLXXXIII, Chapter IX.)

Conclusions Concerning Factor 3

(1) There is much evidence that while many science teachers in Ohio use many techniques in their teaching, and carry forward a wide variety of methods in order to create meaningful science situations, there is a very great weakness on the part of the majority of the teachers. Most of the teachers are one-textbook teachers. Most of the follow almost verbatim the organization of a particular textbook. Many never use the very valuable aids and devices about which they have been queried. There is evidence of weakness in preparation, which must have existed even after the close of World War II, since many of the younger teachers plead ignorant of ability to operate and use certain of the devices described, and thus do not have at their disposal the means for varying the method of their teaching. There is evidence that teachers do not use all of the competencies which they possess, in that in all cases where knowlege was pitted against performance, the latter was much lower than the former. Thus there is evidence of weakness of inspiration as well as of preparation.

(2) There is evidence that excellence in the use of an abundance of well-chosen techniques and methods pays dividends in the form of greater effectiveness as a teacher. No excellent teacher ranked below excellent in this respect. Few teachers who were less than excellent in overall performance were rated as excellent in their use of a variety of methods. Competence in methodology appears to be closely related to competence in teaching.

Factor 4

Other factors being equal, effective learning is more likely to occur when the teacher is living the life of a normal citizen in the community, exerting community leadership appropriate to his educational position.

Items which relate to the leadership of Ohio's science teachers in the community and to the normality of their life in the community have been summarized as follows:

(1) In church leadership, almost 44 percent of the county teachers, and almost 49 percent of the city teachers had positions of leadership in the church at the time of this study. These varied in number from one to four or more positions for each individual. The median county teacher who held such a position had been a church leader more than three years, and the median city teacher more than five years. (Tables CCXCVI and CCCXXI, Chapter VIII.)

(2) More than half of Ohio's science teachers were at the time of this study actively leading out-of-school youth organizations. The percentage was more than 52 for the county, and more than 53 for the city teachers. Some held positions of leadership in as many as four different youth groups simultaneously. (Tables CCXCVII, CCXCVIII, CCCXXIII, and CCCXXIV, Chapter VIII.) The greatest number of positions of leadership were held in the Boy, Girl, and Cub Scouts.

(3) Approximately two thirds of the county teachers of science, and 63 percent of the city teachers belonged to at least one civic, social, or fraternal organization. Many belong to two, three, four, or even five. The Masonic bodies had greater affiliation than any other group. (Tables CCXCIX, CCC, CCCXXV, and CCCXXVI, Chapter VIII.)

(4) More than 40 percent of the county science teachers, and more than 43 percent of the city teachers had participated in community drives for funds within the two years preceding this study. The greatest number had taken part in Red Cross drives. Next in order of number was the Community Chest. (Tables CCCII, CCCIII, CCCXXVII, CCCXXVIII, Chapter VIII.)

(5) When queried concerning their opinion of whether or not teachers in their community usually took part in community moves for the common good, more than 72 percent of the county teachers and more than 80 percent of the city teachers answered

in the affirmative. (Summary, Chapter VIII.)

(6) When queried concerning whether or not they believed that their community permitted teachers to lead a normal life, more than 76 percent of the county teachers replied in the affirmative and more than 90 percent of the city teachers did likewise. (Summary, Chapter VIII.)

Conclusions Concerning Factor 4

(1) There is considerable evidence that not only were science teachers in Ohio exerting community leadership commensurate with their educational and professional position, but that they were exerting leadership beyond the call of their professional position in the community. No other group within the community, with the possible exception of the ministers, could muster the comparative number of leaders in religious, youth, community, and national movements for the common good which have been disclosed in this study.

(2) There is considerable evidence that science teachers, by and large, were leading reasonably normal lives in their communities. First, in quite sizable numbers and proportions they have been invited into and have taken part in the social, fraternal, and civic life of their community. Second, and this point cannot be overlooked, they have declared that they believe themselves to be in a favorable position in their own communities.

This situation has not always existed¹ but seemed to exist at the time of this study.

Factor 5

Other factors being equal, effective learning is more likely to occur in our society when the teacher has a well-thought-out and consistent philosophy of teaching and when the teaching practice is consistent with the philosophy.

Evidence concerning this factor was gathered from the teachers themselves. While the teachers were not asked to state a philosophy, they were asked what they hoped to accomplish in their teaching, and it was felt that if a consistent philosophy was present, some indication would be found in the response to this question. Teachers were not asked the question concerning philosophy directly since the investigator felt that to do so would be to invite the repetition of textbook definitions and platitudes which would be meaningless in the light of actual belief.

The results have been summarized as follows:

(1) Of the 926 teachers who responded, 87 attempted no answer. Of the remainder, 350 stated that they were attempting to develop understanding, attitudes, and appreciations. Another 316 said that they wanted to make science functional in living.

¹

See footnotes 78, 79, 80, 81, in Chapter III.

A large number proclaimed that they hoped to develop scientific thinking, and another group desired to arouse and broaden interest. More than a hundred were, they said, attempting to meet the needs of adolescents. A smaller group stated such ideas as "to prepare for college." Some teachers gave more than one answer. In some cases these various answers given by the same person were related, in others they were not. (Table CCLXVIII, Chapter VIII.)

(2) Additional evidence was gained from the forty-teacher study. Of the excellent teachers, five ranked excellent in this factor and three ranked good. Of the ten good teachers, seven were good and three were fair. Of the 11 fair teachers, two were good, eight fair, and one was poor. Of the 11 poor teachers, six were fair, and five were poor. This rating was dependent not only on statement or other evidence of a consistent philosophy, but also on evidence of teaching practice consistent with philosophy. (Tables CCCLXXX-CCCLXXXIV, Chapter X.)

Conclusions Concerning Factor 5

Evidence listed under Factor 3 in this chapter indicates that while teachers have given evidence of some understanding concerning desirable objectives for science teaching in a democracy, their practice falls far short of moving in the direction of

attaining the ends sought. The typical Ohio science teacher, according to the evidence listed under factor three is a one-textbook, subject-matter centered teacher who teaches from the textbook often because he is not sufficiently well prepared to do otherwise. "Developing scientific thinking," "developing understandings, attitudes, and appreciations," "making science functional in living," have been stated as objectives growing out of philosophies of the majority of the science teachers of Ohio yet they have given evidence of approaching these objectives through a one textbook, textbook centered type of teaching.

There is evidence to conclude that while the majority of Ohio's science teachers profess objectives which could spring only from an understanding of a rather forward looking philosophy, the practice is far short of the claim. Too many teachers cry with the one who answered the question concerning field trips somewhat as follows: "But if I do these things, when do I get time to cover the book?"

Factor 6

Other factors being equal, learning will proceed more effectively when the teacher is skilled in the use of classroom aids and devices, when he is familiar with, has accumulated, and uses teaching materials of various kinds, and when he knows about and uses sources of information beyond the single textbook.

With factor 6, much of the information is indirect, some of it is direct. Indirect data include those which stem from the teacher having placed himself in position to learn about the use

of classroom aids and devices through membership in certain science-teaching organizations, etc. Direct data include those obtained in answer to questions addressed to teachers and from the results of the forty-teacher study. Following are the items:

(1) Some science teachers in Ohio were members of the National Science Teachers Association, and as such received regularly packets of materials which include aids and devices for use with science classes. Only a very small minority of the teachers reporting indicated membership in this organization, however (88 of 965). (Summary, Chapter VIII.) Some teachers belonged to the Academy of Science, and so were familiar with the aids and devices made available by the academy. The membership in the academy was small, however, amounting to 92 of 965 teachers reporting.

(2) Science and science education magazines often describe or list aids and devices for use in science teaching. Of 539 teachers of science in the county schools, 80 claimed to read no science or science-education magazines, while 64 said that they did not regularly read such magazines. Of those who did report such magazines read, a relatively small number reported magazines of the science-education type. In the city schools, 35 of the teachers reported that they never read these magazines and 25 reported none read regularly. A higher percentage of city teachers reported reading magazines of the science-education type,

but the proportion was quite low. (Tables CCXCI and CCCXVII, Chapter VIII.)

(3) Less than one third of the county science teachers had read any scientific books except secondary texts, and less than five percent any science-education books during the two years prior to this study, according to their own accounting. City teachers were better readers, having listed 46 percent of their number for science books and more than 11 percent for science education books.

(4) Items one through ten of Factor 3, which were a summary of part of the findings in Chapter IX apply to this factor as directly as they do to Factor 3. These items relate to use of movies in teaching, ability of teachers to operate, repair and adjust moving picture projectors, ability to use and extent of use of film-strip projectors, ability to use and extent of use of recorders, use of exhibits, construction of equipment, use of field trips, use of libraries, and use of printed materials other than the textbook and workbook. Reference is made to Factor 3 and to the summary of Chapter IX for further discussion.

(5) Almost one third of the teachers of science said that they were not familiar with the state sources for materials which might aid them in the teaching of science. More than 43 percent

of the teachers said that they never used such sources. (Summary, Chapter IX.)

(6) More than four teachers in every five claimed to be familiar with two or more sources of printed tests, and only about 13 percent of the teachers said that they always used their own tests. (Summary, Chapter IX.)

(7) Half of Ohio's teachers who reported said that they never had used a resource unit in their teaching. Many had never heard the term used. Rural teachers were less likely to have used a resource unit than were city teachers. (Summary, Chapter IX.)

(8) More than 40 percent of the teachers claimed never to make use of any sources for free and low-cost teaching materials, even though only one teacher in three said he was not familiar with listings of sources for such materials. (Summary, Chapter IX.)

(9) More than half of the teachers claimed that they knew nothing of the work of the Junior Academy of Science, and only a little more than ten percent had participated in the science fairs during one of the two years preceding the study. (Summary, Chapter IX.)

(10) More than one teacher in every five never used governmental publications of any kind in his science teaching. (Summary, Chapter IX.)

(11) Most science teachers of Ohio said that they regularly or usually followed the organization of a particular textbook in

presenting the work of the course. (Summary, Chapter IX.)

(12) A greater percentage of county than of city teachers claimed that the pupils worked with them in planning the course. Teachers reported that the pupils aided them in about 43 percent of the cases. (Summary, Chapter IX.)

(13) All teachers who rated as generally excellent except one rated excellent in use of aids and devices and the other items included in Factor 6. (Table CCCLXXX, Chapter X.)

(14) All of the teachers who ranked as good except one ranked good in use of aids and devices, etc. This one teacher ranked excellent. (Table CCCLXXXI, Chapter X.)

(15) Of the 11 fair teachers, five ranked good and six were considered fair in this factor. (Table CCCLXXXII, Chapter X.)

(16) Of 11 poor teachers, one was credited with being good, five were fair, and five were poor in use of aids, devices, etc. (Table CCCLXXXIII, Chapter X.)

Conclusions Concerning Factor 6

Conclusions concerning Factor 6 must take into account not only what the teacher knows about the use of aids and devices, but the extent to which the teacher has accumulated and uses such devices, and the extent to which he has advanced his teaching beyond the confines of the textbook through use of additional information and sources of information. Conclusions have been

given as follows:

(1) There is considerable evidence that teachers of science in Ohio are very poorly acquainted with sources of aids, devices, materials, and helps aside from those usually thought of in considering the formal textbook-centered course. There is evidence that they do not know about the helps offered by the state agencies, federal agencies, commercial groups, science and science-education associations, and even the community agencies within their own communities. There is further evidence that not nearly all who do know about such sources for information make use of them. Evidence points rather strongly to the general conception of the textbook-centered course with little place in it for aids, devices, teaching materials, and additional sources of information.

Certainly this condition is by no means universal, but it apparently does exist in too large a segment of Ohio's educational pattern.

(2) There is evidence that excellence in this factor is at least related to excellence in general teaching effectiveness, and that mediocrity in this factor is accompanied by mediocrity in teaching effectiveness.

Factor 2

Other factors being equal, learning will proceed more effectively when the teacher has established rapport with the learners and when the learners believe that the teacher is well informed and effective.

This factor was somewhat difficult of application. Probably the best data concerning it were obtained in the forty-teacher study. Certain other items have indirect bearing, however. These follow:

(1) It is difficult to believe that students can believe their teacher to be well informed and effective when he presents no post-secondary science credit at all. But of 2541 teachers in the state, 139 had no such credit, and 40 more had no post-secondary preparation in the major field of their science teaching. Many more had no preparation in minor fields of science teaching. Of the 2541, additionally there were 644 who had preparation in only one science. General science teachers in the county schools were in particularly poor situation with little preparation in the wide range of fields covered in this type of work. (Tables LXIII, LXIV, LXIX, and LXX-LXXV, Chapter V.)

(2) Many teachers were frank in admitting partial competence in handling their science work and some admitted total incompetence. More than one teacher in every five felt only partially competent. (Summary, Chapter IX.)

(3) All of the excellent teachers in the forty-teacher study were classed as excellent in this factor. (Table CCCLXXX, Chapter X.)

(4) Of the ten good teachers, one was excellent, eight were good, and one was fair in this factor. (Table CCCLXXXI, Chapter X.)

(5) Of 11 poor teachers, one was rated good, three fair, and seven were ranked poor in this factor. (Table CCCLXXXII, Chapter X.)

Conclusions Concerning Factor 7

(1) When so many teachers were completely unprepared in the subjects they were teaching and so many were completely unprepared in any form of scientific endeavor, when so many teachers felt incompetent, or only partly competent, it is difficult to understand how any large segment of their pupils could believe them "well informed and effective." One cannot escape the conclusion that the teachers of Ohio, to a considerable extent, cannot be rated too highly on this factor.

(2) Effectiveness in teaching science as rated in the forty-teacher study seemed to have been related somewhat closely to effectiveness in the factor designated. Excellence in this factor seemed to be associated directly with excellence in general teaching. There were a few individuals who seemed to rate somewhat higher in this factor than their general rating might indicate.

Factor 8

Other factors being equal, learning will proceed more effectively when the major professional interest of the teacher and his major expenditure of time and energy are concerned with teaching and not with some other occupation.

(1) The out-of-school employment of teaching personnel has been regretted by some, and others have made unsupported statements concerning this extra-contractual income.

As reported by the science teachers of Ohio, approximately half do no work for pay during the school year beyond that which is done in connection with their teaching job. Another 30 per-cent work ten or less hours per week. Less than one in every five works beyond ten hours per week, and not more than one in fourteen works more than 20 hours per week. With those who work a long hourly period the problem may become acute. Certainly a teacher who works 40 hours per week beyond the regular teaching time is not devoting a fair share of time and energy to the teaching position.

By and large, however, the problem does not appear to be too acute state-wide, however acute it may be in certain instances. (Tables CCCVII and CCCXXXII, Chapter VIII.)

(2) In the forty-teacher study, of the eight who rated excellent, five were excellent in this respect, three were good. Of ten who were good in their overall effectiveness, two were excellent, six were good and two were fair. Of the 11 who rated fair, two were excellent, five were good, three were fair, and one was poor. (Tables CCCLXXX, CCCLXXXI, CCCLXXXII, Chapter X.)

Conclusions Concerning Factor 8

(1) Out of school employment of the teacher (and indirectly

the devotion of the teacher to work outside the school) seem not to be so serious in the state of Ohio as feared by some. While the problem may be acute locally, it appears not to be too serious on a large scale.

(2) The results of the forty-teacher study cast some doubt on the validity of the factor since there appears to be less relationship between this factor and teaching effectiveness in general than would be consistent with the results obtained. A much wider sampling would be necessary before such a finding could be justified.

Factor 2

Other factors being equal, learning will proceed more effectively when there is rapport and mutual respect between the science teacher and his immediate supervisor.

There was some direct evidence concerning this factor, chiefly from the forty-teacher study. Principals were particularly frank in discussing the matter of teacher-principal rapport and were open in discussing the factors which they felt were important in building rapport. They mentioned professionalism, discipline, good conduct of the science situation, teacher competence in his work, teacher knowledge of subject and of pupil, as well as other items. The following list gives a summary of the evidence which has been obtained regarding the various facets of teacher-supervisor rapport.

(1) Of the county teachers of science, only 112 of 539 showed their professionalism by belong to any type of science or science-education organization. In the city, 238 of 426 belonged to some such group. (Tables CCXC and CCCXVI, Chapter VIII.)

(2) Teachers were not avid readers of science and science-education magazines and books. Generally speaking they were ill-informed concerning current science and science-education literature, and knew few of the recent books, particularly in science education. (Items 1, 2, and 3 concerning Factor 6.)

(3) The poor preparation exhibited by many of the teachers of science in Ohio is a factor which cannot be ignored in dealing with mutual respect. (See Tables LXIII, LXIV, LXIX, Chapter V.)

(4) In the forty-teacher study, of eight who ranked excellent, seven rated excellent and one good in this factor, of the ten who were good, six were rated as excellent and four were good. Of the 11 fair teachers, four were good, six were fair, and one was poor. Of the 11 poor teachers, one was listed as good, five were fair, and five were poor. (Tables CCCLXXX-CCCLXXXII, Chapter X.)

(5) More than 20 percent of the teachers admitted that they were incompetent or only partially competent in their own science situations. This item has a bearing on the feeling of mutual respect which teachers and their supervisors should have for each other.

Conclusions Concerning Factor 9

(1) Teachers who are untrained or poorly trained cannot command the respect of their supervisor. Even the supervisor who is himself untrained in science can recognize the signs of the untrained teacher. The fact that so many of Ohio's teachers of science have no preparation in any of the sciences, or have such weak preparation is certain to have a deleterious effect upon the relationship between science teacher and supervisor.

(2) Principals and other supervisors appreciate professionalism on the part of teachers. The fact that only a minority of teachers of science have shown evidence of interest in their work by attempting to work with other teachers in the field cannot be appreciated by the supervisor.

(3) While teachers generally ranked slightly better than their general rating in this factor of rapport, there was a definite relationship throughout. Evidence tends to support the general thesis of the factor.

Factor 10

Other factors being equal, learning will be more effective if the teacher is not carrying an excessive load, either by reason of an excessive number of preparations, an excessive number of pupils per day, or an excessive extra-curricular or out-of-school series of responsibilities.

Quite a bit of evidence exists concerning factor 10 in its application to science teaching in the state of Ohio. This evidence is of various kinds and has been presented as follows:

(1) In the smallest category of county schools, nearly one third of the local executives were teaching science. This number was a little greater than one of five for the next larger county schools, one of seven for the largest county schools, and somewhat more than one of five for the principals of the exempted village schools. (Table XCI, Chapter VII.)

(2) In almost half of the smallest category county schools there was only one individual teaching science, and he usually taught other subjects as well. This figure dropped to 31 percent for the next larger category, and to 12 percent for the largest category of county schools. Additional subjects taught included almost every subject area in the curriculum but with special emphasis on mathematics and the social studies, Physical education was taught by many. (Tables XCII, XCIII, and XCIV, Chapter VII.)

(3) Teachers in the county schools whose major area was in almost every field of the curriculum also taught science. (Tables C-CVIII, Chapter VII.)

(4) In the smallest schools, one fourth of the teachers had six, seven, or eight separate preparations. In the next larger category, the percentage of those having six or more preparations had dropped to 14 percent, with less than two and one half percent similarly situated in the largest category of county schools. In the county schools, the median preparation load was four preparations, while in the city schools it was two preparations

per day. (Tables CIX, CXXVIII, Chapter VII.) In all categories there was an average of one study hall per day.

(5) In all categories of schools, the median class load was five classes per day and the median pupil load was in the 101-125 pupil range. (Summary, Chapter VII.)

(6) With increase in the number of pupils per grade there was a corresponding decrease in the number of those who taught "science combination" and a corresponding increase in those who taught only one area of science. (Summary, Chapter VII.)

(7) The per capita number of extra-class duties for county teachers was 1.92, for city teachers was 2.00. The number who had no extra-class duties was negligible. (Tables CCCIV, And CCCXXIX, Chapter VIII.)

(8) Approximately one fifth of the county and one eighth of the city teachers believed their extra-class duties hurt their science teaching. Approximately two teachers of five believed that they helped the teacher to teach more effectively. The rest believed that there was little difference. Tables CCCV and CCCXXX, Chapter VIII.)

(9) Only a small fraction (about four percent) believed that out-of-school community activities were harmful to the work of teaching science, almost half of the teachers believed that this community work helped their teaching, the rest saw little difference. Tables CCCVI, and CCCXXXI, Chapter VIII.)

(10) Approximately half of the science teachers of Ohio have no extra-contractual employment for pay during school months. Approximately nine percent of the county and six percent of the city teachers are gainfully employed more than 20 hours per week during school months. (Tables CCCVII and CCCXXII, Chapter VIII.)

(11) In the forty-teacher study, of the ten excellent teachers, six rated good from the standpoint of teacher load, while two rated fair. Of the ten good teachers, one rated excellent, six were good and one was fair. Of the 11 fair, two had teaching loads which rated as excellent, nine were good. Of the poor teachers, one had an excellent teaching load, four were good, three were fair, and three poor.

Conclusions Concerning Factor 10

(1) Administrative duties required of the teacher probably hurt the science teaching in many of the county and exempted village schools. This conditions disappear in the city schools to a large extent, since no city principal was a classroom teacher of science.

(2) Excessive numbers of preparations existed in all of the county schools, and to such an extent in the smaller county schools that the effectiveness of most science teachers cannot help but be impaired seriously. With a median preparation load of five separate preparations per day in the smallest category,

and with many teachers having six, seven, and eight preparations per day, preparation for class becomes meaningless. Textbook teaching is the only alternative to complete class disintegration for teachers who have the numbers of preparations which are expected of many county teachers. Beyond the actual number is the fact that the preparations may lie in as diverse areas as, for example, biology, physics, commercial areas and foreign language. The organization pattern of the very small school poses a preparation sequence upon the teacher which makes for a very poor educational program and ineffective teaching.

(3) The number of classes taught per day was not, in general, found to be excessive. The median throughout was five classes and one study hall. Whether or not this load is excessive depends on several other items, one of which is the number of double-period sections included in the five sections listed.

(4) The load of extra-class duties seemed somewhat excessive to this investigator (an average of approximately two per teacher) but few teachers, comparatively, complained about this number as an over-load. A much greater number saw the extra-class activities as being of help. Out of school activities in which the teacher took part also was viewed as helpful by the teachers.

(5) The problem of the teacher who is performing extra-contractual work for pay outside school hours but during the school year seems to be not so serious state-wide as it had been foreseen from comment in certain current literature. The

indications are that this problem may be serious in certain localities in the state and almost non-existent in others.

(6) In the forty-teacher study, there seemed to be little relationship between the difficulty of assignment and the effectiveness of the teacher. Probably this situation is too complex to admit of a simple statement. There is no evidence to show but that the excellent teacher would have been better with a more favorable working day. The statement "all other factors being equal" probably is the crux of the matter. Certainly favorable schedules did not guarantee excellence of teaching, neither did an unfavorable schedule result in poor teaching on the part of the excellent teachers. This question needs further investigation.

Factor 11

Other factors being equal, the overall pattern of school effectiveness will be greater (hence learning will be more effective) in a school which has a wide, but not overbalanced, variety of science offerings than in one which has a very limited number of such offerings.

(1) Of 372 high schools in the smallest category of schools, only nine offered as many as four types of science. There were 34 which offered only one, and 164 offered but two. (Table OCLXXV, Chapter VII.) In the medium-sized county schools, four of 329 offered only one science, 54 offered two, 224 offered three, and only one offered five sciences. (Table OCLXXVI, Chapter VII.) In the largest category of county schools, three offered two

subjects, 45 offered three, and 14 offered five. The remaining schools offered four subjects. (Table CCLXXVII, Chapter VII.) Most of Ohio's exempted village schools offered four subjects, although one offered only two and five offered five sciences. (Table CCLXXVIII, Chapter VII.) Only one city school offered two sciences. Almost all offered four or more. (Tables CCLXXIX-CCLXXXII, Chapter VII.)

(2) Of the many "minor" subjects offered, senior science was most offered (91 schools), physiology next (35 schools), aeronautics next with 16 offerings, and botany next with 14. There were 39 minor sciences mentioned as being given by one or more schools. (Table CCLXXXIII, Chapter VII.)

Conclusions Concerning Factor 11

(1) Conditions reported in this study indicate that the science curriculum in the small school in Ohio is so narrow as to be very limited in its usefulness. Schools which offer only one or two sciences would be hard put to defend their treatment of the science needs of young people in the world of today. Even in some of the larger schools, the program has been limited to two or three sciences, and great areas of scientific experience cannot have been included under the frameworks which have been described.

Even though 39 minor sciences were reported by various high schools in Ohio, the very great majority of high schools reported

no subject outside the standard four subjects, two of which have been in high school curriculums since the earliest days of the existence of separate high schools. The evidence shows that in the main, the subjects of the science curriculum in most Ohio high schools has not changed since the introduction of general science probably thirty years ago and of general biology fully that many years ago.

Factor 12

Other factors being equal, more effective learning is likely to occur when the program of the school is directed toward providing for the special needs of the youth of the community (but not neglecting general needs) than when the program is not so directed.

Efforts to meet specialized needs of youth in the community have been met in the introduction of certain science courses into the curricula of certain Ohio high schools. Trumbull county schools have introduced conservation as a subject, largely due to the fact that the rural areas of this county are well known as rich farming areas. Jefferson county has introduced coal mining science as a vocational area for the young people of that county who will work in the mines. Martins Ferry has introduced geology because of the general interest in rock strata and coal strata exposed in and near this river community.

Other communities have introduced specialized sciences such as advanced biology, advanced chemistry, home economics chemistry,

industrial chemistry, and museum training. (Table COLXXXIII, Chapter VII.)

Conclusions Concerning Factor 12

Little evidence has been discovered which would lead to any general conclusion that the special needs of young people are being cared for within the framework of the science programs of most Ohio high schools. The present programs seem to be, so far as can be indicated by the titles of the courses, rather a standardized college preparatory group of courses which have had little external change in thirty years. It was not possible, within the extent of this study, to make any widespread determination concerning adaptations which have been made within the framework of the present standard science subjects such as chemistry and physics, but the textbook centeredness of the teachers makes it very unlikely that the special needs are being cared for in any very complete fashion.

Despite the presence of a few minor subjects in the Ohio high school science program, it must be concluded that there have been relatively feeble efforts to care for the special needs of the youth in his community.

Factor 13

Other factors being equal, more effective learning is likely to occur when the program of the school is directed toward providing for the general educational needs of youth (but not neglecting the specialized needs) than when the program is not so directed.

There is little evidence that the science program in the schools of Ohio was directed toward fulfilling the general educational needs of youth to any greater extent than it has been doing for some thirty years. Chemistry and physics are strictly college preparatory subjects in many schools. Enrollments, particularly in physics, were quite low.

Such evidence as exists follows:

(1) In the state of Ohio, the following subjects, which probably have general education implications, were given by one or more schools: advanced science, applied science, descriptive chemistry, descriptive physics, eleven science, level science, life science, nature study, personal science, practical biology, practical science, senior science, and tenth grade science. In most cases these subjects were given by only a few schools. Senior science was offered by 91 schools. (Table CCLXXXIII, Chapter VII.)

Conclusions Concerning Factor 13

General science, when properly taught, should furnish science experiences which would be of great importance in helping fill the general educational needs of youth in the high schools. As was shown earlier in this chapter, too much of the time general science is taught at least in the smaller schools by anyone who has a vacant place in his schedule. There is no evidence that

a standard textbook course in general science is the most valuable and worthwhile means of meeting general educational needs in the science area.

Further, if general educational needs exist in the science area, there probably are experiences in this scientific world of today which should be general to individuals after they have gone beyond fourteen-year-oldedness which is the time at which most students work in general science. In most schools, however, general science is the only area of science which is required, and by many it is the only science taken. While the number of classes in biology in the state was encouraging, there was a very great difference between number of chemistry classes and the number of general science classes. Physics classes were very much lower in incidence than general science classes.

Thus the evidence shows that while probably the majority of the high school students were taking general science and biology, only a minority took chemistry and physics. Thus any attempt at general education within the pattern of the standard four subjects must be undertaken in general science and biology, and if we are to reach the greatest number it must be undertaken in general science.

Advanced science, applied science, senior science and the rest of the minor subjects seem not to have had state-wide impact, with the exception of senior science. Even here, only a small

minority of schools have been affected. Additionally, while these subjects ostensibly were placed in the curriculum to furnish vehicles for filling general needs, they never have become general even in the schools which have adopted them. There were very few schools in the state which had enough classes even of senior science to have one teacher teaching a major portion of his time in the area. Too often, according to such meager evidence as exists, they have been merely another subject which some, but not most, non-college preparatory students have taken. Unless they are in a sense general (in the sense of reaching students generally) they can be said to miss the point of furnishing general educational experience.

The general program of teaching science in the secondary schools of Ohio seems, on the basis of the little evidence at hand, to be weak in filling the need for general educational experiences in the area of science. Chemistry and physics have remained predominantly college preparatory in nature, biology has in many cases become college preparatory, and general science, at least in many schools, has become a subject to be taught by "just anyone."

Factor 14

Other factors being equal, learning will proceed more effectively when the learners and the teacher sense the direction of the teaching, when both participate in the planning, and when

the learners see the fulfillment of their own aims implicit in the objectives of the course.

Some evidence concerning this factor was obtained by reference to the teachers of Ohio, a little was found in the forty-teacher study. The evidence follows:

(1) In the state as a whole, slightly more than one half of the teachers claimed that they planned the work of the course with no assistance of any kind from the students. A somewhat larger proportion of county than of city teachers claimed that the students helped them in the planning. More city teachers than county teachers gave guarded answers which included, for the most part, a statement to the effect that while the pupils might help a little, the teacher did the great share of the work of planning. (Summary, Chapter IX.)

(2) Of the eight excellent teachers in the forty-teacher study, all but one made extensive use of teacher-pupil planning, and this one made "good" use of such planning. Of the ten good teachers, one made excellent use of the pupils, six rated as good, and three were fair. Of the 11 fair teachers, one planned well with his pupils, eight engaged in a little teacher-pupil planning, and two did no such planning so far as could be discovered. Of the 11 poor teachers, two engaged in a little such planning, the rest made no attempt to plan the work with the students. (Tables CCCLXXX-CCCLXXXII, Chapter X.)

Conclusions Concerning Factor 14

(1) With over half of the teachers of the state who responded to the study making no use of pupil-teacher planning, there are implications for the in-service education of teachers as well as for the pre-service teaching programs. It is difficult for one to imagine a student seeing the fulfillment of his aims implicit in the objectives of the course when he has had no opportunity to help in the development of aims of the course. It is difficult for him to sense the direction of the teaching when this direction is arrived at by dictum in which he has no opportunity to express his thoughts.

There are implications in this situation for administrators and for boards of education also. It is scarcely possible for the teacher who has six, seven, or eight periods of work per day in three or four unrelated areas of a curriculum to engage in much student planning of a high degree. The organization pattern of the very small school makes such a situation difficult, but not impossible. One of the instances in the forty-teacher study was of a teacher in a small school who had persevered in his work in student-teacher planning and had brought it to a highly successful stage, even though he had a number of preparations and other responsibilities.

Factor 15

Other factors being equal, learning will proceed more effectively if the amount and type of laboratory equipment needed to

fulfill the aims of the work is present and is operating condition, and if the number and type of aids, devices, supplies and materials are at hand and in condition to be used.

(1) According to the rating of the state supervisors, more than half of the laboratories and science rooms of the smallest category of high schools (together with the apparatus and equipment) were regarded as less than satisfactory. More than one third of the next larger schools were so rated, and somewhat less than a third of the largest county high schools had the same rating. About one of every five exempted village school science rooms was judged to be less than satisfactory, and about one ninth of the city schools likewise. Few schools were rated as excellent in their science facilities. (Tables LXXXV, LXXXVI, LXXXVII, Chapter VI.)

(2) County schools were in much poorer situation with regard to possession of certain standard items of laboratory equipment and facilities than were exempted village schools, which were in turn worse off than were the cities. Few schools of any classification and all of the items or services. (Tables LXXXVIII, LXXXIX, and XC, Chapter VI.)

(3) According to reports from the teachers of the state, satisfactory laboratories were more than twice as likely to be found in city schools. The teachers rated more than half of the laboratories in the city schools as adequate or better, and indicated that less than two percent were totally inadequate. In the county schools, one laboratory in every seven was deemed totally inadequate. (Summary, Chapter IX.)

(4) More than 36 per cent of the teachers believed that their laboratory furniture was in good condition. About one teacher in every five believed it to be in poor condition.

(5) Whereas only about 18 per cent of the city teachers listed the condition of their science laboratory equipment and apparatus as being poor or non-existent, approximately 46 per cent of the county teachers felt this way about their equipment.

(6) Of those responding to the question, the greatest number of teachers believed that their school had spent between one cent and one dollar per pupil on permanent equipment during the preceding two-year period. Almost four per cent of the schools, however, reported expenditures in excess of ten dollars per pupil during that time.

Conclusions Concerning Item 15

As in other respects, county schools seem to have suffered from low budgets for the purchase, maintenance, and upkeep of science laboratories and equipment. Many small county schools had no room which could be called a science room, and many more had only a small amount of out-of-date formalized teaching equipment. Even in the cities, where the teachers were faced with better conditions, only a little more than half of the teachers deemed their laboratories adequate for their purpose.

In this respect there is a weakness apparent in using figures presented by the supervisors of the state department. Consciously or unconsciously these individuals must compare what each school has with what other schools have, and, it is suspected sometimes lose sight of the ideal condition. Thus the best-equipped school may tend to become the ideal, even though that school is far short of furnishing the equipment, apparatus, and supplies which the teacher himself sees are needed.

Thus it is not the intent of this investigator to discount too greatly the statements of the teachers themselves when they indicate that of all of the high school laboratories in the state on which reports were received, barely more than half were even satisfactory.

It is concluded that:

(1) Most of the laboratories of the state, from the evidence submitted, need the immediate expenditure of sizable sums of money to equip them with a sufficient variety of new equipment if science teaching is to prosper as it should.

(2) School budgets for science equipment need to be raised considerably beyond the amounts listed by the median schools is reported in this study. On the basis of one dollar for each pupil during a two-year period, the expenditure on a basis of 125 science pupils would be one hundred twenty-five dollars, a very small sum to care for the needs of the young people. Yet this is often much more than the science teacher has available

for his students' needs. Too often the expenditures have stopped entirely, as one teacher said, "for years, and years, and years."

Factor 16

Other factors being equal, learning will proceed more effectively in a good physical environment than in a poor one.

The items relating to physical environment came directly from the science teachers of the state. They follow:

(1) The general physical facilities of the school were judged good by two teachers of every five in the state (more than one of every two in the cities). Poor physical conditions existed in six per cent of the city schools, almost 22 per cent of the county schools. (Summary, Chapter IX).

(2) More than 36 per cent of the teachers believed their laboratory furniture to be in good condition. About one teacher in five thought the furniture was in poor condition. (Summary, Chapter IX).

(3) Most science rooms were kept well painted or reasonably well painted. Only 12 per cent of the teachers responded otherwise. The percentage was almost the same in the county schools as in the city schools.

(4) Good janitorial service was the rule in more than half of the schools. Only 15 per cent reported poor janitorial service.

(5) Almost ten per cent of the teachers reported poor heating and ventilating conditions in their rooms.

(6) Approximately 44 per cent of the teachers said that their rooms were not equipped with window shades or not equipped with shades that were suitable for their work.

Conclusions Concerning Item 16

While the physical conditions surrounding science teaching in the State of Ohio apparently are far from ideal, it appears from the data that physical conditions are such that they should not handicap the teacher too greatly except in the minority of schools. By and large, physical conditions as reported seemed not to be too serious -- not serious at all in fact if comparison is made with conditions which were extant during the depression years and the war years. From the results obtained, it seemed to be easier for the teachers to have new paint than to have new apparatus.

Factor 17

Other factors being equal, learning will be likely to be more effective when considerable attention is given to problem solving, development of critical thinking, and scientific attitudes.

Evidence concerning this factor was obtained solely from the forty-teacher study, although there was some evidence of an indirect nature in the expressions of teachers regarding their

objectives in science teaching. Quite a large number of teachers claimed to be striving for the type of teaching envisioned in this factor, but there was little concrete evidence to indicate how far the teachers had gone in this direction. The evidence follows:

(1) In the forty teacher study, of the eight excellent teachers, five were regarded as excellent in this type of teaching, while three were judged to be good. Of the ten good teachers, seven were rated as good and three were fair. Of the 11 fair teachers, six were reported to be fair and five were poor. Of the 11 poor teachers, all but one were rated poor. This one exception was given a fair rating. (Tables CCCLXXX - CCCLXXXIII, Chapter X).

Conclusions Concerning Factor 17

This study has produced no conclusive evidence concerning the application of factor 17 to the teaching of science in Ohio on a state-wide base. Such evidence as exists tends to show that factor effectiveness in this factor follows rather closely to general effectiveness. More investigation is needed on this factor.

General Summary

While not all of the findings of this study have been included in the preceding seventeen expositions, all of the pertinent items

have been so included.

On the basis of the preceding data and conclusions, Chapter XII has been written with the purpose of developing recommendations which can be justified on the basis of the data at hand. It also contains the general conclusions of the study.

CHAPTER XII

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

A study of the findings concerning the 17 factors of effectiveness as given in the preceding chapter must lead the student to the opinion that science teaching on Ohio's public secondary schools suffered from many ills at the time of this study. Inadequate laboratory facilities, particularly in the smaller schools, lack of recency of preparation, particularly among teachers in the larger schools, insufficiency of education in the sciences among teachers in all categories, paucity of professional experiences of meaningful kinds, poor physical facilities, lack of utilization of the creative urges of pupils in planning the work, lack of desire or ability on the part of the teachers to utilize the resources of the community, all are involved in the problem.

The picture is not all dark — there were evidences of a growing concern on the part of teachers in some respects. A comparison with earlier studies showed that Ohio's secondary teachers of science were better prepared than they had been but a few years earlier. They were seen to be better prepared than were science teachers from certain states as reported in other studies performed in the last half dozen years. Teachers of science seemed to be community-minded, church-minded, and service-

minded to a very high degree. They appeared to be living a reasonably normal life in their communities. They appeared to be aware, in their thinking at least, of objectives for teaching in a democracy.

Recommendations for Further Study

The present study has been indicative rather than exhaustive. In some respects, little attention has been given to important items. It is suggested that further study is needed seriously on at least the following subjects:

(1) The entire subject of pupil-teacher rapport needs further investigation. Not enough study has been made of the effect of this factor on teaching effectiveness. Not enough data was obtained in the state-wide study to justify sweeping conclusions or recommendations with regard to its presence or absence as a factor in improving or damaging the teaching of science in Ohio.

(2) Further time and study should be spent on the problem of the effect of rapport and mutual respect between supervisor and teacher on the effectiveness of the process of teaching. The only evidence pertaining to this matter was obtained in the forty-teacher study, and it is felt that this evidence was too fragmentary to be entirely conclusive. Study needs to be given to the problem at state-wide level so that those who prepare teachers and those who

select and work with teachers may have some notion regarding the extent of the problems which may be caused by poor rapport and by lack of mutual respect.

(3) Little has been done in this study or in any other study concerning the philosophies of science teachers. While this study has made a little more than a bow in the direction of attempting to relate the stated beliefs of teachers with their practice, much more needs to be done. A study of at least doctoral extent could make a valuable contribution to knowledge in this matter.

(4) More study needs to be given to the place of the science teacher in the community. This study has shown the teacher to be a community leader who believes himself, in general, leading the life of a normal citizen. Other studies quoted earlier have placed the teacher in the position of a second-class citizen. Further study concerning this matter should prove enlightening.

(5) Much might be learned by repeating this study (or portions of it) in other states, or, if trends are to be considered, by repeating salient parts of it in Ohio after the lapse of a period of years.

(6) Further studies are needed to define more accurately the teaching load of the science teacher. Future investigators would thus have more accurate yardsticks on which to base their findings.

(7) Much attention needs to be given to the science curricula of the schools of Ohio with a view to determining whether or not the rather gloomy picture presented in this study concerning care of

general needs and care of specialized needs of pupils is, in fact, justified.

(8) Using the results of the present study as a basis, the teacher education institutions of Ohio should proceed further in studying the needs of the schools of Ohio with a view to re-studying their teacher-preparatory curricula.

(9) More attention needs to be given to studies which point in the direction of improved in-service education for teachers already in the field.

(10) It is recommended that studies be conducted looking toward the emerging position of the science teacher as a science consultant in correlated programs of education or in core curriculums. There has been little indication in the present study of a movement in this direction within the public schools of Ohio, but there is a ground-swell which calls for investigation in order that teachers be prepared for what may be a new role in the educational pattern.

General Recommendations

(1) Pre-service Education. It is recommended that teacher preparatory institutions without delay institute programs of teacher education which will prepare the teacher in training more adequately for his work with the youth of the state. There was no evidence that younger teachers, as represented by the great numbers of teachers in the county schools were particularly more alert to the problems facing teachers than were those who received their

training in a long-past era. Accordingly it is recommended that serious thought be given to changing the teacher-preparatory work in such fashion that the teachers entering the schools will be competent in all respects to take their place as educational leaders within and without the four walls of their schoolroom. In particular, the results of this study have shown need that better preparation be in evidence in the following items:

- (a) Development of ideas, objectives, and philosophies concerned with the teaching of science in a democracy.
- (b) Deeper and broader preparation in the subject-matter areas of science. More specialization to the extent that the individual teacher receives a greater conception of the sciences, perhaps less specialization and greater breadth in that at present too many teachers have preparation in only one science and thus lack the knowledge of the inter-relation of the sciences.
- (c) Much greater attention to the teacher's functional knowledge concerning child growth and development and the principles of learning.
- (d) The development of a broad general education.
- (e) The development of proper community attitudes, and their implementation in actual practical situations, so that the teacher-to-be will be able to move into

the positions of educational and professional leadership which he will certainly occupy.

- (f) Adequate, functional professional preparation including competence in operating, repairing, adjusting laboratory equipment, knowledge about ordering laboratory supplies, and all of the other techniques which so many beginning teachers lack. When one of every four science teachers in Ohio expresses some insecurity in his laboratory situation, a program designed to orient the teacher-to-be into the practical aspects of his work is indicated.
- (g) Cultural contacts which are somewhat beyond those required by a strict interpretation of the term "general education." These are indicated because of their importance in dealing with the community, their work with fellow teachers, with their supervisors and with the students.
- (h) Work which looks toward an integration of the science experiences. This work should give the teacher-to-be a sense of the relationship between the various sciences, a sense of the permeating influence of science in the life of man today, and a sense of the place of science in the world today. Evidence which exists indicates that teachers have not had this type

of integrating experience. Certainly the teacher who is teaching with no science preparation, the one who has had a small number of hours in one science, even the one who has had a somewhat more extensive subject-matter preparation in a science has had little opportunity thrust upon him to view science as a permeating influence in the lives of the students of today.

- (1) Work which will give the teacher-to-be a conception of his place as the leader, the resource person, to whom the students must turn if he wishes to have rapport with them, and if he wishes to be a real teacher. Thus the teacher should, before he begins his teaching, have some method of getting to know that he will be expected to give to youth that orientation in science which will enable them to have a general outlook and also which will serve them in good stead as they make vocational plans.

(2) In-service Education. While many new teachers enter the secondary schools of Ohio each year, a glance at Chapter V indicates that the majority of science teachers are those who have been in the schools, and in their present positions, for some time. We must continue to teach science with those who are now teaching it. While

new teachers entering the system may be better trained than were their older co-workers, the number of new teachers entering each year is not sufficient to cause a revolution in science teaching. Further, the new teachers tend to pattern after the older ones. If we are to have better science teaching in the immediate future, it must come because we are able to improve the teachers who are already in the schools of the state. Therefore, a strong program of in-service education is urgently recommended. Because of the dimensions of the problem, it is recommended that the program be undertaken not only on a local level, but also on a state-wide level.

The machinery exists, because of the fact that state universities are strategically located over the state, for the introduction of a program of in-service education for teachers at state level.

While the development of a complete in-service program of education for teachers is beyond the scope of this study, it should tend to combat the teacher weaknesses which were uncovered in earlier portions of the investigation. If one-fourth of the teachers feel insecure in their science teaching, something can be done about it through in-service education. If over half of the teachers of Ohio do not use the aid of pupils in their planning, something can be done about opening the eyes of the teachers to

the possibilities for education inherent in this procedure. If great numbers of teachers in the state do not use aids and devices because they do not know about them, if they do not use materials issued by national science and science-teacher organizations because they do not know about them something can be done concretely to care for these inadequacies. As has been noted previously, the development of a program is beyond the scope of this study, but teacher weaknesses can be corrected as they appear.

In general, programs of in-service education for teachers could be classified into several headings as follows:

- (a) Special graduate courses for teachers in-service.
- (b) Workshops for science teachers wherein teachers might pursue work concerning their own areas of weakness.
- (c) Reading programs for science teachers.
- (d) Visitation
- (e) Sectional meetings of science teachers.

Further Recommendations

(1) It is recommended that science and science-education associations make further efforts to develop materials which will be valuable to teachers, and that they redouble their efforts to bring such materials to the attention of science teachers. Many teachers in the answers to the questionnaire concerned with this study requested

information concerning such groups as Science Clubs of America, the Junior Academy, The National Science Teachers Association, etc. It is felt that these organizations have not made their presence felt to the average teacher. It is recommended that as a beginning point, these organizations might work through the teacher-preparatory institutions, as some of them have begun to do.

(2) It is recommended that boards of education in Ohio endeavor to select teachers so that they may teach in their major area of interest and preparation, and it is recommended that administrators endeavor to arrange schedules to involve the least possible number of separate preparations on the part of the teacher. It is recommended that especial attention be given to the problem of teaching general science, and that general science teachers be employed on the same basis as are other teachers, rather than being given some general science to teach as an after thought to a day's schedule of English, Latin, commercial, or other work.

(3) Boards of education are urged to increase science budgets radically at the present time on an emergency basis. Results of this study indicate that in great numbers of Ohio's schools, little has been done in many years to modernize laboratories, and to procure equipment, apparatus, and materials which are suitable for the teaching of science. With half of the teachers of the state viewing their science rooms as being less than adequate, it is time that the situation be reviewed and emergency spending declared.

(4) In the interest of more effective science teaching and learning, it is recommended that the state department of education continue its present plan of consolidating the very small schools of the state so that proper teaching facilities may be ensured to the science teachers (as well as other teachers) and so that better schedules, more adequate equipment, and broader curriculums may ensue. Some 24 of the smallest county schools had no room which could be recognized as a science room. Many of the smallest schools were teaching only one or two sciences. Many of the smallest schools were requiring the teacher to teach one or two sciences and as many as five or six other subjects, all in unrelated fields. These conditions do not make for effective teaching. Consolidation is the most feasible method of eliminating at the root some of these poor practices in science teaching.

A Final Word

It is hoped that the present study will arouse questions which will lead to further study of the conditions indicated and hinted at in this investigation. It is hoped that other students may take the challenge to push further into many of the problems which face science teachers and science teaching in the schools of the present day.

Further there is a sincere hope that the results of this study may be used to improve and make more effective science teaching in the State of Ohio and in other areas of the nation.

FACTORS RELATED TO THE EFFECTIVENESS OF
A LEARNING SITUATION IN SECONDARY
SCIENCE

The following characteristics have been ascribed to an effective learning situation in secondary science. You may or may not agree with any or all of these characteristics. On the other hand, you may agree with a characteristic with certain qualifications to your agreement. Note that there is one qualification present in each statement, namely: Other factors being equal. This qualification should be taken into account throughout.

There is no thought that this list of characteristics describes completely an effective learning situation. Rather, it merely constitutes what is believed to be a partial list which may serve as the basis for a study.

It is requested that you make note of your agreement or disagreement by circling the appropriate word, or that you make use of the space provided for qualifying your answer. Space has been provided at the end for addition of other pertinent points, or for your comment.

It is hoped that you will be able to complete this form and return it in the enclosed stamped envelope. Thank you.

Warren M. Davis

-
1. Other factors being equal, effective learning is more likely to occur when the teacher has a broad background of knowledge in the particular science he is teaching as well as in the related scientific areas.

Agree Disagree

Qualification: _____

-
2. Other factors being equal, effective learning is more likely to occur when the teacher has a functional knowledge of how children develop and how learning takes place.

Agree Disagree

Qualification: _____

-
3. Other factors being equal, effective learning is more likely to occur if the teacher know about, understands, and uses a variety of methods of instruction as opposed to the exclusive use of one or two methods.

Agree Disagree

Qualification: _____

4. Other factors being equal, effective learning is more likely to occur when the teacher is living the life of a normal citizen in the community, exerting community leadership appropriate to his educational position.

Agree Disagree

Qualification: _____

5. Other factors being equal, effective learning is more likely to occur in our society when the teacher has a well-thought-out and consistent philosophy of teaching and when the teaching practice is consistent with the stated philosophy.

Agree Disagree

Qualification: _____

6. Other factors being equal, learning will proceed more effectively when the teacher is skilled in the use of classroom aids and devices, when he is familiar with, has accumulated, and uses teaching materials of various kinds, and when he knows about and uses sources of information beyond the single textbook.

Agree Disagree

Qualification: _____

7. Other factors being equal, learning will proceed more effectively when the teacher has established rapport with the learners and when the learners believe that the teacher is well informed and effective.

Agree Disagree

Qualification: _____

8. Other factors being equal, learning will proceed more effectively when the major professional interest of the teacher and his major expenditures of time and energy are concerned with teaching and not with some other occupation.

Agree Disagree

Qualification: _____

9. Other factors being equal, learning will proceed more effectively when there is rapport and mutual respect between the science teacher and his immediate supervisor.

Agree Disagree

Qualification: _____

10. Other factors being equal, learning will be more effective if the teacher is not carrying an excessive load, either by reason of an excessive number of preparations, an excessive number of pupils per day, or an excessive extra-curricular or out-of-school series of responsibilities.

Agree Disagree

Qualification: _____

11. Other factors being equal, learning will be more effective in a school which has a wide variety of science offerings than in one which has a very limited number of such offerings.

Agree Disagree

Qualification: _____

12. Other factors being equal, more effective learning is likely to occur when the program of the school is directed toward providing for the special needs of the youth of the community rather than when the program is not so directed.

Agree Disagree

Qualification: _____

13. Other factors being equal, more effective learning is likely to occur when the program of the school is directed toward providing for the general educational needs of youth than when the program is not so directed.

Agree Disagree

Qualification: _____

14. Other factors being equal, learning will proceed more effectively when the learners and the teacher sense the direction of the teaching, when both participate in the planning, and when the learners see the fulfillment of their own aims implicit in the objectives of the course.

Agree Disagree

Qualification:

15. Other factors being equal, learning will proceed more effectively if the amount and type of laboratory equipment needed to fulfill the aims of the work is present and in operating condition, and if the number and type of aids, devices, supplies, and materials are at hand and in condition to be used.

Agree Disagree

Qualification:

16. Other factors being equal, learning will proceed more effectively in a good physical environment than in a poor one.

Agree Disagree

Qualification:

17. Other factors being equal, learning will be likely to be more effective when considerable attention is given to problem solving, development of critical thinking and scientific attitudes.

Agree Disagree

Qualification:

Please list any other factors, similar in intent to the preceding which you believe important enough to warrant inclusion in such a list.

Signature

**ALLIANCE HIGH SCHOOL
ALLIANCE, OHIO**

**WARREN M. DAVIS, PRINCIPAL
O. A. ANDREANI, ASST. PRIN.**

March 30, 1951

To members of NASSP:

As a portion of my doctoral study at the Ohio State University, I wish to validate certain characteristics of an effective learning situation in the area of secondary science. In order to approach this problem, statements have been chosen which describe conditions which may or may not bear on the effectiveness of the learning situation.

In each case, there is given an opportunity to indicate whether you agree or disagree with the statement as it stands, also to indicate any qualification you may wish to make. Additionally, space has been provided at the end of the paper in order that you may add further statements which you believe have particular significance and which have not been included. You may, if you wish, use this space for making general comments.

Please note that no attempt has been made to include all of the characteristics of an effective learning situation. However, if you feel that very important characteristics, worthy of study, have been omitted, you are invited to add them to the listing.

It is hoped that you will be able to complete this short form within a few days and to return it in the enclosed stamped envelope. Since only two members of NASSP are being contacted in each state (except Ohio), it is requested that you fill out the form and return it if at all possible.

Thank you for your assistance.

Sincerely,

Warren M. Davis
Warren M. Davis
Director of High Schools

ALLIANCE HIGH SCHOOL
ALLIANCE, OHIO

WARREN M. DAVIS, PRINCIPAL
O. A. ANDREANI, ASST. PRIN.

March 30, 1951

To members of NSTA:

As a portion of my doctoral study at the Ohio State University, I wish to validate certain characteristics of an effective learning situation in the area of secondary science. In order to approach this problem, statements have been chosen which describe conditions which may or may not bear on the effectiveness of the learning situation.

In each case, there is given an opportunity to indicate whether you agree or disagree with the statement as it stands, also to indicate any qualification you may wish to make. Additionally, space has been provided at the end of the paper in order that you may add further statements which you believe have particular significance and which have not been included. You may, if you wish, use this space for making general comments.

Please note that no attempt has been made to include all of the characteristics of an effective learning situation. However, if you feel that very important characteristics, worthy of study, have been omitted, you are invited to add them to the listing.

It is hoped that you will be able to complete this short form within a few days and to return it in the enclosed stamped envelope. Since only a selected few members of NSTA are being contacted, it is hoped that all will respond.

Thank you for your assistance.

Sincerely,

Warren M. Davis
Warren M. Davis
Director of High Schools

ALLIANCE HIGH SCHOOL
ALLIANCE, OHIO

WARREN M. DAVIS, PRINCIPAL
O. A. ANDREANI, ASST. PRIN.

December 15, 1950

To members of AASA:

As a portion of my doctoral study at the Ohio State University, I wish to validate certain characteristics of an effective learning situation in the area of secondary science. In order to approach this problem, statements have been chosen which describe conditions which may or may not bear on the effectiveness of the learning situation.

In each case, there is given an opportunity to indicate whether you agree or disagree with the statement as it stands, also to indicate any qualification you may wish to make. Additionally, space has been provided at the end of the paper in order that you may add further statements which you believe have particular significance and which have not been included. You may, if you wish, use this space for making general comments.

Please note that no attempt has been made to include all of the characteristics of an effective learning situation. However, if you feel that very important characteristics, worthy of study, have been omitted, you are invited to add them to the listing.

It is hoped that you will be able to complete this short form within a few days and to return it in the enclosed stamped envelope. Since only two members of AASA are being contacted in each state (except Ohio), it is being requested that you fill out the form and return it if at all possible.

Thank you for your assistance.

Sincerely,

Warren M. Davis
Warren M. Davis
Director of High Schools

269

ALLIANCE HIGH SCHOOL
ALLIANCE, OHIO

WARREN M. DAVIS, PRINCIPAL
O. A. ANDREANI, ASST. PRIN.

November 30, 1950

To members of NARST:

As a portion of my doctoral study at the Ohio State University, I wish to validate certain characteristics of an effective learning situation in the area of secondary science. In order to approach this problem, statements have been chosen which describe conditions which may or may not bear on the effectiveness of the learning situation.

In each case, there is given an opportunity to indicate whether you agree or disagree with the statement as it stands, also to indicate any qualification you may wish to make. Additionally, space has been provided at the end of the paper in order that you may add further statements which you believe have particular significance and which have not been included. You may, if you wish, use this space for making general comments.

Please note that no attempt has been made to include all of the characteristics of an effective learning situation. However, if you feel that very important characteristics, worthy of study, have been omitted, you are invited to add them to the listing.

It is hoped that you will be able to complete this short form within a few days and to return it in the enclosed stamped envelope. If you include pertinent comments, it is requested that you sign the form, since such comments may require a later exchange of correspondence.

Thank you for your assistance.

Sincerely,

Warren M. Davis
Warren M. Davis
Director of High Schools

Form A
(Form for recording data from Ohio High School Principals' annual reports)

Name of School _____ City _____

Size of school _____ County _____

Name of Teacher _____

Area of Major Teaching _____ No. of classes _____

Area of Minor Teaching _____ No. of classes _____

Further Areas of Teaching _____

Highest Degree held _____ Number of preparations daily _____

Number of semester hours of each subject presented by teachers

Physics _____ Chemistry _____ Biology _____ Zoology _____

Botany _____ Physiology and Health Sciences (including Anatomy, etc.) _____

Bacteriology _____ Astronomy _____ Geology, Geography _____

General Science _____ Other Sciences (specify) _____

Professional Education Courses _____ semester hours

Science Courses Offered by the School:
(check courses offered)

General Science _____ Biology _____ Botany _____

Zoology _____ Physiology _____ Chemistry _____

Physics _____ Astronomy _____ Consumer Science _____

Senior Science _____

Other sciences (specify) _____

Form B. PERSONAL QUALITIES.

1. What types of work have you performed other than teaching which offered valuable experience so far as the teaching of science is concerned?
(Working in a research laboratory, or in a steel mill, for example.)
1). _____
2). _____
3). _____
2. Over how long a period of time did each such experience extend?
1). _____ years. 2). _____ years. 3). _____ years.
3. What hobbies have you developed which are useful to you in the teaching of science and how long have you had such hobbies?
1). _____ 1). _____ years.
2). _____ 2). _____ years.
4. What school work have you completed which has been useful to you in the teaching of science, but which does not appear on your official transcript?
(Trade schools, for example.) _____

5. To what scientific or science teaching associations or organizations do you belong? _____

6. What science or science education magazines do you read regularly?

Occasionally? _____

7. What science or science education books have you read in the past two years (aside from textbooks of secondary-school level)? _____

8. Please list any other pertinent factors of training which you believe have been of significance to you in your science teaching and which do not appear either in your college transcript or elsewhere in this supplemental list of questions. _____

9. What position of leadership do you hold in a church or in any church organization? _____
 Over how long a period of time have you held this or a similar position of leadership? _____
10. List any out-of-school activities involving youth in which you participate or have recently participated in a position of leadership (such as Boy Scouts, etc.). _____

11. List fraternal, social or service organizations of which you are a member. (Such as Masons, Kiwanis, Grange.) _____

12. List any "drives" or similar community movements in which you have taken an outstanding part in the past two years. (Such as Red Cross, Community Chest, etc.) _____

13. Do teachers in your community usually or often assume positions of leadership in movements for the common good? _____
14. Do you believe that your community permits teachers to live a "normal" life? _____
15. List your school responsibilities aside from teaching. 1). _____
2). _____ 3). _____ 4). _____
16. Do you believe that the amount of time and energy taken by your school responsibilities other than teaching (such as extra-curricular activities) are detrimental to your teaching or that these activities help your teaching? Harmful _____ Helpful _____ No difference _____
17. Do you believe that the community work you are required to do because you are a teacher hurts your efficiency as a teacher, or makes you a better teacher? Hurts _____ Helps _____ No difference _____
18. How much time do you spend during the regular school year in some gainful occupation other than your regular schoolwork? None _____. One to ten hours per week _____. Eleven to twenty hours per week _____. Over twenty hours per week _____.
19. List your curricular load in terms of number of pupils taught, and number of preparations per day. Total number of pupils in classes each day _____. Number of different preparations per day _____. Number of study halls _____.

Form C. METHOD, PHYSICAL EQUIPMENT, ETC.

1. In your teaching, do you make use of movies frequently? _____
occasionally? _____ not at all? _____
2. Can you operate a 16 millimeter moving picture projector of the type
commonly found in the schools? _____
3. Can you make minor adjustments and repairs to a moving picture
projector? _____
4. Do you use filmstrips or filmslides frequently? _____ occasionally?
_____ not at all? _____
5. Can you operate a filmstrip or filmslide projector? _____
6. Can you make home-made slides which are appropriate for use in a science
class? _____ Do you ever make and use such slides? _____
7. Can you operate a recording and transcribing device of any type--disk,
tape, or wire? _____
8. Do you use recordings and transcriptions frequently? _____ occasionally?
_____ not at all? _____ in your teaching.
9. Do you make use of models, live exhibits, dioramas, etc. in your teach-
ing frequently? _____ occasionally? _____ not at all? _____
10. Do you or members of your class construct models, exhibits, etc. for
class use frequently? _____ occasionally? _____ not at all? _____
11. If you or members of your classes wish to carry out experiments or
demonstrations for which equipment is not available, do you devise
(or aid pupils in devising) such equipment frequently? _____
occasionally? _____ not at all? _____

12. Do you feel competent to work with normal laboratory and demonstration equipment in high school science, thoroughly? _____ partially? _____ do not feel competence in handling such equipment? _____
13. Do you find it advisable to make use of your community for the purpose of taking your science classes outside the classroom frequently? _____ occasionally? _____ not at all? _____
14. If the preceding answer is "not at all" why do you not use such trips?

15. Do you and your students use school or public library materials as source materials for your work in science frequently? _____ occasionally? _____ not at all? _____
16. Do you use printed or written materials aside from the textbook, laboratory manual, and workbook frequently? _____ occasionally? _____ never go beyond these sources for information? _____
17. Do you make use of one basic textbook or do you use two or more textbooks regularly as sources of information? One _____ Two _____ More than two _____
18. Do you bring local materials and other community resources (including speakers) into your classes frequently? _____ occasionally? _____ not at all? _____
19. Are you familiar with the resources for science teachers which are available from the State museum and a few other such sources such as the State Department of Agriculture? _____
20. Do you use state resources such as those mentioned in the preceding question frequently? _____ occasionally? _____ not at all? _____

- CONFIDENTIAL
21. Are you familiar with at least two sources of printed tests (standardized or otherwise) in science? _____
22. Do you give tests other than those of your own construction frequently?
_____ occasionally? _____ not at all? _____
23. Do you use in your teaching, or have you used within the past two years, a resource unit, whether of your own construction or obtained from any source whatsoever? Am now using. _____ Have used such a unit. _____
24. Are you familiar with such listings of free and low cost materials as the Science Clubs of America Sponsor Handbook, the Peabody Catalog of Free and Low Cost Materials, or similar listings? _____
25. Do you make use of such listings to obtain materials for your classes frequently? _____ occasionally? _____ not at all? _____
26. Are you familiar with the work of Science Clubs of America? _____
Do your students make any use of the materials prepared by this organization? _____
27. Are you familiar with the work of the Junior Academy of Science? _____
28. Have you had any student participate in an exhibit sponsored by the Junior Academy within the past two years? _____
29. Do you use government publications such as the Bulletins of the United States Department of Agriculture or of the Bureau of Mines in your teaching, frequently? _____ occasionally? _____ not at all? _____
30. Do you follow the organization of a particular textbook in developing a plan of teaching for your class? always? _____ usually? _____ never? _____
31. Do you plan the teaching solely, or do the students often or always help in planning the direction of the work? Teacher plans the work _____.
Both teacher and pupils plan the work _____.

32. In your science classroom and laboratory do you have, for the most part, the amount and kind of laboratory and demonstration equipment and the materials and supplies needed to fulfill the aims of the course as it is being presented? Yes_____. Almost_____. Equipment and/or materials and supplies somewhat inadequate_____. Equipment and/or materials and supplies totally inadequate_____.
33. In general is the physical environment in your school, particularly in the science department, good_____ fair_____ or poor_____?
34. Is the laboratory furniture in good_____ fair_____ or poor_____ condition?
35. In general are the instruments, devices, and materials in your laboratory in condition to use or are many of them in need of extensive repair? In condition to use_____. Many need repair_____.
36. Approximately how much money per pupil enrolled in your school has been spent in purchasing laboratory equipment and/or supplies during the past two years (do not include expendable items such as chemicals).
\$_____ per pupil.
37. Is your room kept well painted?_____ fairly well painted?_____ poorly painted?_____
38. Do you consider that the janitorial service in your science department is adequate?_____ fairly adequate?_____ poor?_____
39. Are ventilation and heating adequate for the greatest degree of pupil comfort and health?_____. If not always, are they usually satisfactory?_____. Seldom satisfactory?_____.
40. Is your science room equipped with the proper type of window shades, movie shades, etc. for the best fulfillment of your pupils' needs?_____

36. In how science classroom you demonstrate the use of the science to
the student and the use of the science to the student and the
the student and the use of the science to the student and the

41. In a few words, if you will, please state what you are trying to
accomplish in your science teaching. _____

Signature (if you wish)

969

Form D

(Form for recording data from Visitation Report of State Supervisor)

School _____ City _____

County _____

G. Science

Biology _____ Rooms _____ Equipment _____ Apparatus _____

Chemistry _____ Rooms _____ Equipment _____ Apparatus _____

General Science _____ Rooms _____ Equipment _____ Apparatus _____

Physics _____ Rooms _____ Equipment _____ Apparatus _____

Special Equipment: Teacher's demonstration table _____

Water _____ Gas _____ Electricity _____

Shades _____ Baloptican _____ Motion picture equipment _____

Microprojector _____ Models _____ Charts _____

Specimens _____ Aquarium _____ Germinating beds _____

General estimate _____

Never in the history of educational research has there been a complete state-wide survey of science teaching in the secondary schools of any state. As a part of my doctoral study I hope to obtain a rather complete picture of this area of education in Ohio. With the kind cooperation of the Ohio State Department of Education, a considerable portion of the study has been completed. However, my success in obtaining the remaining part of the pertinent information depends on the help of every teacher in the state of Ohio who teaches one or more classes of any natural science.

First, although I have at hand a record of the formal training of every such teacher, it seems certain that informal training also has a considerable influence on the success or failure of the teacher. Consequently, information relating to this type of preparation is requested. Also, the participation of the teacher in activities within and without the school may directly or indirectly affect teaching efficiency, so questions have been asked relating to this work.

Your methods of teaching certainly have a considerable bearing on your work as a teacher, and I am anxious to know about them. Finally, the condition of your science rooms including the laboratories, and the amount and type of equipment, whether suitable and adequate for your purposes are of importance in any survey of science teaching.

In completing this study I have had the whole-hearted cooperation of the Ohio State Department of Education, of the United States Office of Education, and of the National Science Teachers Association. May I assure you that your name will not be used in any way in connection with the survey, and that you will have the opportunity to make full use of the published results when the work is done? Thank you.

Sincerely,

Warren M. Davis
Warren M. Davis, Principal

WMD:fmk

A PUPIL'S RATING SCALE OF AN INSTRUCTOR

Instructor's name. (Please print) _____ Course _____ Date _____

Each of the qualities listed below is divided into three sections. Each section is divided into three degrees and numbered accordingly from 1 to 9, 1 being the highest degree and 9 the lowest. In rating, draw a circle around the number which best describes your instructor.

Your fair and honest opinion is what really counts. Your instructor desires this rating for his own self-improvement.

ORGANIZATION OF COURSE	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Carefully planned; well organized.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Some organization but not always clear.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Lacks organization and planning.</div>
TEACHING SKILL	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Produces steady interest in subject; creates real desire; keeps things moving.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Teaching procedure seldom changes; student interest moderate.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Classes tend to be dry and uninteresting; class period drags.</div>
PREPARATION FOR EACH CLASS	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Shows definite evidence of careful preparation.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Shows some preparation; materials not always clear in instructor's mind.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Not well prepared; lacks accurate knowledge.</div>
ENTHUSIASM AND INTEREST IN COURSE	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Genuinely interested and enthusiastic.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Appears to be rather passively interested.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Course seems to be uninteresting to the instructor.</div>
ASSIGNMENTS	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Students understand clearly the tasks of each new assignment.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">At times indefinite; often stated somewhat hurriedly.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Unreasonable; hurriedly given; vague.</div>
JUDGMENT OF VALUES	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Selects important ideas; omits unimportant items.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Sometimes overlooks important points, spending time on insignificant details.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Frequently misses important ideas; wanders off on trivial details.</div>
CLASS DISCUSSION AND QUESTIONS	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Questions challenging; demand sound thinking; discussions interesting and stimulating.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Questions rather easy and simple; often calls for memorized facts; discussions ramble.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Asks few questions; very little discussion.</div>
POISE AND SELF-CONFIDENCE	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Well poised; sure of himself; not easily upset.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Seems embarrassed at times; fairly self-confident.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Easily upset; uncertain as to procedure; lacks confidence.</div>
EXAMINATIONS	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Questions thought-provoking; carefully selected; clear.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Questions usually factual; require little thinking.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Examinations poorly planned and managed.</div>
SCHOLARSHIP	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Excellent mastery of subject; wide fund of knowledge in other fields.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Knowledge fair but without depth.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Knowledge frequently very inadequate.</div>
ABILITY TO CREATE STUDENT INTEREST	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Usually stimulates strong interest.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Arouses only mild student interest.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Classes drag and students are indifferent.</div>
CLASSROOM MANAGEMENT AND DISCIPLINE	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Efficient management; pupils orderly and attentive.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Satisfactory organization; few disciplinary problems.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Poor organization; many disciplinary problems.</div>
SPEECH	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Voice pleasant; speaks distinctly fluent.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Speaks fairly well.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Poor voice; words not clear; weak expression.</div>
TOLERANCE	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Encourages students to express opinions even though they differ with the instructor's ideas.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">At times appears to be disturbed and impatient when students oppose instructor's views.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Resents opposition; intolerant.</div>
SENSE OF HUMOR	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Possesses keen sense of humor.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Rather sober and serious; somewhat humorous at times.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Shows little or no humor.</div>
PERSONAL APPEARANCE	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Appearance neat; well dressed and in good taste.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Appearance fair; somewhat untidy at times.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Unkempt; careless and untidy.</div>
RELATIONSHIP BETWEEN STUDENTS AND INSTRUCTOR	<div style="text-align: center;">1 2 3</div> <div style="text-align: center;">Attitude of friendliness; feeling of mutual interest.</div>	<div style="text-align: center;">4 5 6</div> <div style="text-align: center;">Attitude somewhat indifferent; neither ill-will nor friendliness prevails.</div>	<div style="text-align: center;">7 8 9</div> <div style="text-align: center;">Considerable spirit of antagonism between students and instructor; antagonistic air.</div>

On the back of this form, PRINT any annoying mannerisms your instructor has developed which should be corrected. Also PRINT your criticisms of the course. These will be very helpful to your instructor's self-improvements. Do not sign your name.

BIBLIOGRAPHY

- Abba, Ahmed, A., Classification and Analysis of Philosophies of Certain Science Teachers. Doctoral thesis. Greeley: Colorado State College of Education. 1949 (Typewritten.)
- American Association for the Advancement of Science, Co-operative Committee on the Teaching of Science and Mathematics. You Too Can Help the Science Teacher: A Summary of Recommendations and Their Possible Realizations. West Lafayette, Ind.: Purdue University, 1950. 3 p. (Mimeographed.)
- American Association for the Advancement of Science. "Committee Report on the Place of Science in Education." School Science and Mathematics 28:640-664. June 1928.
- American Council of Science Teachers, National Committee on Science Teaching. "Science Teaching for Better Living" and "Re-directing Science Teaching in the Light of Personal-Social Needs." Washington N. E. A. 1942.
- Anderson, Harold H., Brener, Joseph E. and Reed, Mary Frances. Studies of Teachers' Classroom Personalities III. Follow-up Studies of the Effects of Dominative and Integrative Contacts on Childrens' Behavior. Applied Psychology. Monograph No. 11. Stanford University Press. December 1946. 156 p.
- Anderson, Harold H., and Brewer, Joseph E. Studies of Teachers Classroom Personalities, II: Effects of Teachers Dominative and Integrative Contacts on Childrens Behavior. Applied Psychology Monograph No. 8. Stanford University Press. June 1946. 128 p.
- Anderson, Kenneth E., "A Study of Achievement in High School Chemistry in Several Eastern and Midwestern States." Science Education 34:168-76; April 1950.
- Anderson, Kenneth E. The Relative Achievement of the Objectives of Secondary School Science in a Representative Sampling of Fifty-six Minnesota High Schools. Doctoral thesis. Minneapolis: University of Minnesota, 1949. 288 p. (Typewritten.)
- Anderson, Stuart A., "A Study of the Professional Personnel of Wisconsin Secondary Schools with Special Reference to Extra-Contractual Income." Journal of Experimental Education, 18:92-200. September 1948.

- Armstrong, W. Earl, Hollis, Ernest V. and Davis, Helen E. The College and Teacher Education. Washington, D. C.: American Council on Education, 1944. 309 p.
- Ash, F. Elton, "The Effect of Teacher Adjustment Upon Pupil Adjustment." Doctoral Dissertation, Abstracts and References 1940-41. Iowa City: State University of Iowa, 1944. pp. 76-79.
- Bailey, Doyle E. The Use of Community Resources by High School Science Teachers. Doctoral thesis. Greeley, Colorado: Colorado State College of Education. 1950. 88 pp. (Typewritten.)
- Baker, A. LeRoy, "The Development of Science Content Courses for the Training of Elementary School Teachers." Science Education, 25: 97-99. February 1941.
- Baker, Arthur O., "Science in the Cleveland Public Schools" Science Education, 33: 110-51. March 1949.
- Baker, Tunis, "Teaching the Scientific Method to Prospective Elementary School Teachers." Science Education, 29: 79-82. March 1945.
- Barker, Elizabeth, M., "Summary of the Relation of Personality Adjustments of Teachers to their Efficiency in Teaching." Journal of Educational Research, 41:664-75. May 1948.
- Barnard, Darrell (Chmn.) Report of the Science Committee of the Colorado State Course of Study for Secondary Schools. (Mimeographed.)
- Barr, Arvil S. and others, "The Measurement and Prediction of Teaching Efficiency: A Summary of Investigations." Journal of Experimental Education, 16:1-81; June 1948.
- Beauchamp, Wilbur Lee., Mayfield, John C., and West, Joe Young. Teachers Guidebook for Everyday Problems in Science. Chicago: Scott, Foresman and Co. 1941.
- Beauchamp, Wilbur Lee. Instruction in Science. National Survey of Secondary Education Bulletin 1932, Monograph No. 22. U. S. Department of the Interior, Office of Education, Washington, D. C. G. P. O. 1932 pp. ii plus 63.

- Benner, Gladys Vera. The Preparation in the Special Sciences in Institutions of Higher Learning of the Teachers of General Science in American Public Secondary Schools. Doctoral thesis. Philadelphia: University of Pennsylvania, 1940. 151 p. (Typewritten.)
- Billig, Florence G. Technique for Developing Content for a Professional Course in Science for Teachers in Elementary Schools. Contributions to Education No. 397. New York: Teachers College, Columbia University. 1930. 101 p.
- Bingham, N. E., "Workshop for Science Teachers." Science Education 35:177-84. April 1951.
- Bissiri, Attilio. Criteria for Natural Science Curriculum in Junior High Schools. Doctoral thesis. Los Angeles: University of Southern California at Los Angeles, 1946. 269 p. (Typewritten.)
- Blyler, Dorothea, "Certification of Elementary School Teachers in the United States." Elementary School Journal 45:578-89. June 1945.
- Boone, Eleanor J. and Jameson, A. Pringle. "The Training of Science Teachers Serving in the California Schools." California Quarterly of Secondary Education 9:350-9. June 1934.
- Bowers, Harold J., "Round the Mulberry Bush." Educational Research Bulletin, 25:64-6. March 1946.
- Bowman, Earl C. and Sands, Lester B. "Improving the Education of Mathematics and Science Teachers," School Science and Mathematics, 42:407-12. May 1942.
- Brandevin, Paul F. "Time for Change." Time for Science Instruction 1946 Yearbook, National Science Teachers Association, pp. 23-25, 49-50. Washington, D. C.: NSTA, 1946.
- Brown, Myron Davis, Laboratory Facilities and Equipment for General Science and the Physical Sciences. Master's thesis. Columbus: The Ohio State University. 1949. pp. ii plus 153.
- Brunson, Mrs. DeWitt and Dowling, Thomas I. (editors), Suggestions for the Teaching of Science in the Twelve-Year School Program. Columbia, South Carolina: South Carolina State Department of Education. 115 p. 1948.

- Bureau of Educational Research in Science, Teachers College, Columbia University. Report of the Workshop for Science Teachers, Summer 1944. New York: The Bureau, 1944. 45 p. (Mimeographed.)
- Bureau of Educational Research in Science, Teachers College, Columbia University. Report of the Workshop for Science Teachers, Summer 1943. New York: The Bureau, 1943. 65 p. (Mimeographed.)
- Bureau of Educational Research in Science, Teachers College, Columbia University. Report of the Workshop for Science Teachers, Summer 1942. New York: The Bureau, 1942. 81 p. (Mimeographed.)
- Burgess, Anna E. "Suggested Preparation for Teachers of Elementary Science. Science Education 31:61-8. March 1947.
- Burnett, R. Will and Sanford, Charles W. "The Research Program of the Illinois Secondary School Curriculum Program." Science Education 35:65-69. March 1951.
- Cahoon, G. P., "Competency in Science Teaching, Not Credit Hours," Science Education 27:1-6. February 1943.
- Cahoon, G. P., "Teaching Science for General Education in the High School." School Science and Mathematics 49:281-8. April 1949.
- Caldwell, Otis C. and Curtis, Francis D. Teachers Manual for Everyday Science. Boston: Ginn and Company, 1944.
- California Council on Improvement of Instruction, Better Teaching Through the Use of Current Materials. Palo Alt: Sanford University School of Education. 1947. 24 pp.
- Cardinal Principles of Secondary Education. Report of the Committee on the Reorganization of Secondary Education of the National Education Association. Bulletin No. 35. United States Bureau of Education, Washington. 1918.
- Cole, Thomas R., "Measuring Teachers Load in Secondary School Subjects." American School Board Journal, 115:31-32. December, 1947.
- Commission on Teacher Education. A Functional Program of Teacher Education as Developed at Syracuse University. Washington, D. C.: American Council on Education, 1941. 259 p.
- Commission on Teacher Education. Teachers for our Times. Washington, D. C.: American Council on Education, 1944. 178 p.

Commission on the Reorganization of Secondary Education. "Report of Subcommittee on the Teaching of Science." U. S. Bureau of Education Bulletin No. 26. Washington, D. C.: G.P.O. 1920.

Cook, Walter W. and Leeds, Carroll H. "Measuring the Teaching Personality." Educational and Psychological Measurements. 7:399-410. May 7, 1947.

Cooper, Herman, "Role of Certification in Getting Better Teachers." School Management 15:500. May 1946.

Cooperative Committee on the Teaching of Science. On the Teaching of the Basic Sciences. (Reprint from American Journal of Physics 12:359-62. December 1944.)

Cooperative Study of Secondary School Standards, Evaluative Criteria 1950 Edition, Washington, D. C.: Cooperative Study of Secondary School Standards. 1950 pp. iii plus 305.

Coyle, Irvin F., "Teachers Certificates." School and Community. 34:116-7. March 1948.

Creelius, Philipine, "A Report on the Objectives of General Science Teaching." School Science and Mathematics 23:313-9. April 1923.

Crouch, H. B. A Preliminary Report on a Study of Science Education in Negro High Schools of Tennessee. Nashville, Tennessee: Tennessee A & I. College, 1947. pp. ii plus 140. (Mimeographed.)

Crowder, Farnsworth. "Educational Strait Jackets." Survey Graphic 36:617-9. November 1947.

Crowell, Victor L. Jr., "Recent Developments in Science Education at a State Teachers College." Science Education 29:188-90. October 1945.

Cunningham, Harry A., "Lecture Demonstration versus Individual Laboratory Method in Science Teaching. A Summary." Science Education 30:70-82. March 1946.

Cunningham, Harry Allen. Material Facilities Needed for the Training of Intermediate Grade Teachers in Science. Contributions to Education No. 812 New York: Teachers College, Columbia University. 1940 162. p.

- Cureton, Edward E., "The Aim and Content of the Course of Study in General Science for the Junior High School." Master's thesis: Palo Alto, California: Leland Stanford. 1927. Unpublished.
- Curtis, Francis, D. A Third Digest of Investigations in the Teaching of Science. Philadelphia: P. Blakiston. 1939. pp. v plus 419.
- Curtis, Francis D. A Digest of Investigations in the Teaching of Science. Philadelphia, Pa.: Blakiston. 1926. pp. v plus 341.
- Curtis, Francis D. Second Digest of Investigations in the Teaching of Science. Philadelphia, Pa. Blakiston. 1931 pp. v plus 424.
- Curtis, Francis D., "What Problems are Involved in the In-Service Training of Teachers?" The Science Teacher. 16:65-6. April 1949.
- Curtis, Francis D., "The Teaching of Science in the Secondary Schools of the North Central Association." Science Education 17:1-11. February 1933.
- Davis, Calvin, I. "The Size of Classes and the Teaching Load," School Review 31:412-429. June 1923.
- Davis, Warren M., "Preparation of Elementary Teachers in the Field of Science," School Science and Mathematics. 40:238-43. March 1940.
- DeLoach, Will Scott and Hall, (Mrs.) Auborn Russ. Two articles to be published in Science Education entitled, "The Undergraduate Preparation of High School Chemistry Teachers, Alabama, 1948-49," and "Time and Place of Undergraduate Training of a Group of High School Chemistry Teachers. (Manuscript.)
- DeLoach, Will Scott and Hall, (Mrs.) Auborn Russ. "Subjects Taught by High School Chemistry Teachers, Alabama, 1948-49." Science Education 35:259. December 1951.
- Dodds, B. L., Cooperative Planning in Teacher Education." (A report of the Cooperative Committee on the Teaching of Science and Mathematics.) School Science and Mathematics. 50:222-8. March 1950.

- Doll, Ronald C., "High School Pupils Attitudes Toward Teaching Procedures." School Review 55:222-7. April 1947.
- Douglas, Harl R. and Stoud, Raymond., "The Education and Teaching Load of Science Teachers in Minnesota High Schools." Educational Administration and Supervision 22:419-26. September 1936.
- Eidsmore, Russell M. A Pupils Rating Scale of an Instructor. Morningside College: Sioux City, Iowa. (Single page form).
- Elvira, Sister Mary, "Student Opinion on Methods of Teaching." Educational Administration and Supervision 32:74-86. February 1946.
- Engel, Marion. A Study of the Preparation, Assignment, and Experience of Science Teachers in the State of Nebraska. Master's thesis. Lincoln University of Nebraska, 1950. 68 p. (Unpublished.)
- Evenden, Edward S. and Butts, R. Freeman. Columbia University: Cooperative Program for the PreService Education of Teachers. New York Teachers College, Columbia University. 1942. 120 p.
- Ewerate, Warren P., "Term Problems in Secondary Science." Science Education 27:33-6. February 1943.
- Feifer, Nathan, "Course in the History and Development of Science." High Points. 31:5-13. February 1949.
- Ferguson, Thomas Currie. The Status of Science Teachers in Ohio Public Secondary Schools. Master's thesis. Columbus: Ohio State University. (Unpublished.) 90 p.
- Ferguson, William C., "Instructional Problems of Generalized Science in the Senior High School." Science Education 24:72-5. February 1940.
- Ford, Leonard A., "Science Curricula of Teachers Colleges." Science Education, 25:95-97. February 1941.
- Fraser, Thomas P., "Science Teachers Objectives and Attitudes Toward Using Community Resources: A Study of Fifteen Maryland Negro Secondary Schools." Science Education 33:352-61. December 1949.

- Frazier, Benjamin W., "Renewal of Progress in Teachers Certification. School Life 30:18-21. April 1948.
- Gemmill, Anna M., An Experimental Study at New York State Teachers College at Buffalo to Determine a Science Program for the Education of Classroom Teachers. Contribution to Education No. 715. New York: Teachers College, Columbia University, 1937. 74 p.
- Gillette, Frank, "Developing Skills in the Use of Current Materials: A Problem in Teacher Education." Science Education. 35:41-3. February 1951.
- Glenn, Earl R., "Needed Research Studies in Junior High School Science Teaching." Science Education. 32:175-85. April 1948.
- Gonder, Frank Cullen. A Survey of General Science in the Nine Bay Counties. Master's thesis. San Francisco: San Francisco State College. 1950. (Typewritten.)
- Graham, Malcolm. The Present Status of Some Significant Methods of Teaching Biology in the Public High Schools of Massachusetts. Master's thesis. Amherst: University of Massachusetts. 1948. Pp. i plus 83. (Typewritten.)
- Grant, Charlotte L. "Meeting Student Needs by Integration." School Science and Mathematics. 51:193-98. March 1951.
- Guba, Egon G. A Statistical Analysis of Some Factors Involved in Preparation of High School General Science Teachers. Digest of Master's thesis. Lawrence, Kansas: University of Kansas. 1950. 8 p. (Mimeographed.)
- The Harvard Committee, General Education in a Free Society. Boston: Harvard University Press. 1948. 267 p.
- Hatcher, Hazel. Characteristic Differences Among Homemaking Teachers of Varying Proficiency. Bulletin No. 288. Lansing, Michigan: State Board of Control for Vocational Education. 1944. 90 p.
- Heiss, Elwood D., Obourn, Ellsworth S., and Hoffman, Charles W. Modern Science Teaching. New York: The Macmillan Co. 1950. 462 p.
- Hicks, Charles M., "The Preparation of Science Teachers for the Scholastic Year 1934-35." Master's Thesis. Austin, Texas: University of Texas. 1935. 81 p. (Typewritten.)

- Hoff, Arthur G., Secondary-School Science Teaching. Philadelphia: The Blakiston Co. 1947. pp. xi plus 303.
- Hunter, George W. and Spore, Leroy. "Science Sequence and Enrollments in Secondary Schools of the United States." Science Education 25:359-70. December 1941 and 26:66-77. February 1946.
- Hunter, George W. and Parker, Alice L. "Subject Matter of General Science." School Science and Mathematics. 42:869-77. December 1942.
- Hurd, Archer, W. Summary of Analysis Blanks Returned in the Investigation of Teacher Training in Science. New York: Institute of School Experimentation, Teachers College, Columbia University. 1932. (Mimeographed.)
- Hurd, Archer W. "Professional Subject Matter in Teacher Training." Science Education 16:238-43. February 1932.
- Hurd, Archer W., "Professionalization of Subject-matter Courses in the Education of Science Teachers." Educational Administration and Supervision 19:173-80. March 1933.
- Hurd, Archer W. "An Analysis of Some Professionalized Subject-matter Courses in Science in Teacher-Training Institutions." Science Education 17:277-80. December 1933.
- Hutson, Percival W. "The Training of High School Teachers in Minnesota. Educational Monograph . No. 3. Minneapolis. College of Education, University of Minnesota. 1923.
- Johnson, Philip G., "Some Developments in Science Teaching and Testing." School Science and Mathematics. 50: 187-99. March 1950.
- Johnson, Philip G., "Information Concerning Science Education Research 1949-1950." Science Education. 35:193-7. October, 1951.
- Johnson, Philip G., "Some Trends in Senior High School Science with Implications for the Preparation of Teachers." Science Education. 33:13-15. February 1949.
- Johnson, Philip., "Some Implications of Scientific Methods for Secondary Education." School Life. 31:1-4. July 1948.

Johnson, Philip G., "Adaptations of the Physical Sciences to the Needs of Secondary Pupils." American Journal of Physics 15:480-3. November-December 1947.

Johnson, Philip G., "The Meanings of Science." The Science Teacher 17:161-163. November 1950.

Johnson, Philip G., "Science Education Research in the Division of Secondary Education of the United States Office of Education." Science Education 32:169-74. April 1948.

Johnson, Philip G. The Teaching of Science in Public High Schools: An Inquiry into Offerings, Enrollments, and Selected Teaching Conditions 1947-48. U.S. Office of Education Bulletin 1950. No. 9. Washington, D. C.: Government Printing Office, 1950. 48 p.

Joseph, Alexander, "The Changing Scene in Science Education." The Science Classroom 28:1,4: October, 1948.

Kaplan, Louis, "New Horizons in Teacher-Community Relationship." Journal of Educational Sociology 21:417-27. March 1948.

Klise, Katherine S. and Oliver, George L., "Biology-An Evaluation." Science Education. 31:164-71. April 1947.

Klohr, Paul Robert, "A Study of the Role of the Resource Unit in the Curriculum Reorganization of Selected Secondary Schools." Abstracts of Doctoral Dissertations. No. 57, 1947-48. Columbus: Ohio State University. 1949. p. 111-60.

Knight, Edgar W., "Intelligent Teacher Certification." School Management 15:422. April 1946.

Laton, Anita D. and Powers, S. Ralph. New Directions in Science Teaching. New York: McGraw-Hill Book Co., 1949. 164 p.

Lee, J. Warren, "Status of the Natural Science Teacher in Negro High Schools of Louisiana." Science Education 34:36-40. February 1950.

Lichliter, Mary, "Social Obligations and Restrictions placed on Women Teachers." School Review 54:14-23. June 1946.

Lowry, Nelson L., "Biology and Physical Science for Ninth and Tenth-Grade Students." Science Education 35:71-73. March 1951.

- Lund, S.E. Forsten, The Subject-Matter Preparation of Science Teachers in Minnesota High Schools 1934-35. Doctoral thesis. Minneapolis: University of Minnesota. 1936. (Typewritten.)
- Maaske, Roben J., "Improving the Pre-Service Preparation of Teachers." Forthcoming Development in American Education. Proceedings of the Fourteenth Annual Conference for Administrative Officers of Public and private Schools. Chicago: University of Chicago Press. 1945. pp. 35-46.
- Mallinson, George G., "Preparing Critic Teachers to Supervise and Teach Elementary Science." Science Education 32:254-8. October 1948.
- Mallinson, George G. and Sams, Conway C., "An Investigation of the Subject-Matter Competence of Student Teachers in Science." School Science and Mathematics 51:461-9. June 1951.
- Mallinson, George G., "State Requirements for Certifying Teachers of High School Science." School Science and Mathematics 51:543-56. October 1951.
- Mallinson, George G., "The Implications of Recent Research in the Teaching of Science at the Secondary School Level." The Journal of Education Research. 43:321-342. January 1950.
- Mallinson, George G., Materials of Consumer Science for the Junior High School. Doctoral thesis: University of Michigan. 1947. pp. vii plus 159.
- Mallinson, George G., "A Report to the National Association for Research in Science Teaching on the Activities for 1949-50 of the Cooperative Committee on the Teaching of Science and Mathematics of the American Association for the Advancement of Science." Science Education 34:177-80. April 1950.
- Mallinson, George G., "State Requirements for Certification of Teachers of Elementary Science." Science Education 33:288-91. October 1949.
- Martin, Edgar., "The Present Status of Instruction in General Biology." The American Biology Teacher. 13:149-57. November 1951.
- Martin, Edgar. Inquiry into the Teaching of General Biology 1949-50. U. S. Office of Education Questionnaire. 1950.

- Martin, Edgar., "The Present Status of Instruction in General Biology." The American Biology Teacher 13:149-51. November 1951.
- Mathewson, Franklin Thurber. A Study of the Contributions of Certain Professional Activities to the In-Service Education of Science Teachers in Secondary Schools. Doctoral thesis. New York: New York University. 1941. 449 p. (Typewritten.)
- McCook, Nebraska, "Report of An Investigation, McCook, Nebraska: Administration in a Small Community." Washington, D. C.: National Committee on Defense of Democracy Through Education. (Commission of the N E A.) 1947. 28 p.
- McDaid, Elmer W. and others., "What is your Teacher's Work Week?" School Executive 66:41. July 1947.
- McGrath, D., "Have you Considered Geology-An Ideal Subject for Curriculum Enrichment?" Science Education 33:51-55. February 1949.
- McGrath, D., "Some Experiences with Teacher-Pupil Planning of Laboratory Work in Chemistry." School Science and Mathematics 44:793-7. December 1944.
- Mead, Margaret, "Teacher's Place in American Society." American Association of University Womens Journal. 40:3-5. October 1946.
- Meister, Morris., "Science Rooms for Secondary Schools." Science Education. 32:143-5. April 1948.
- Miles, Vaden W. A Determination of the Principles and Experiments Desirable for a High School Course in Integrated Physical Science. Doctoral thesis. Ann Arbor: University of Michigan. 1947. 207 p.
- Miller, D. F., "A Summary of Part of the Questionnaires Sent to Teachers of Biological Science in Secondary Schools." The American Biology Teacher 3:221-7. April 1941.
- Miller, Miles M. and Katherine Dresden, "Current Approaches in the Teaching of Science." School Science and Mathematics. 49: 359-65. May 1949.
- Morse, Stanley W., "High School Science Experiences of 506 Non-Science Curricula College Students." Science Education 34:117-26. March 1950.

National Association of Secondary-School Principals. Planning for American Youth. Washington, D. C.: National Education Association. 1951. pp. 1 plus 64.

National Committee on Science Teaching. The Education of the Science Teacher. Washington, D. C.: National Education Association. 1942. 74 p.

N. E. A. Research Division., "The Teacher Looks at Personnel Administration." Research Bulletin. 23:95-147. December 1945.

National Science Teachers Association Advisory Council on Industry-Science Teaching Relations. How Science Teachers Use Business-Sponsored Teaching Aids. Washington, D. C.: The Association. 1950. 35 p.

National Science Teachers Association. Teaching Condition and the Work Week of High School Science Teachers. Bulletin 1947-48. Washington, N. S. T. A. 1948. 18 p.

National Society for the Study of Education. Program for Teaching Science. Thirty-first Yearbook of the National Society for the Study of Education, Part I. Bloomington, Illinois: Public School Publishing Co., 1932.

National Society for the Study of Education. Science Education in the American Schools. Forty-Sixth Yearbook, Part I. Chicago: University of Chicago Press. 1947. 306 p.

Nelson, Dale Elton, "Making Teachers Aware of the Science Teaching Resources in Their Community." Science Education. 35:69-71. March 1951.

Nicholls, Wayne., "Status of Nebraska Science Teachers." Science Education 25:213-5. April 1941.

Nicholson, Douglas G., "What is a Good Teacher?" School Science and Mathematics 51:597-601. November 1951.

Noll, Victor H. The Teaching of Science in the Elementary and Secondary Schools. New York: Longmans Green and Co. 1939. 238 p.

North Central Association of Secondary Schools and Colleges, Commission on Secondary Schools. Statistical Summary of Data from Annual Reports. (Form A-2) 1951. 10 p. (Mimeographed.)

Ohio State Department of Education. Educational Directory School Year 1950-51. Columbus: The Department. 1951. pp. 1 and 145.

On the Teaching of Basic Science. (A Committee Report.) American Journal of Physics. 12:359-62. December 1944.

Otto, Cliff R., "Training Needed for Chemistry Teachers." The Science Teacher 18:287-8. December 1951.

Palmer, E. Lawrence, "How To Increase Natural Resource Planning and Conservation Education in our School Program Through Biological Science." School Science and Mathematics 47:619-24. October 1947.

Peterson, Shailer, "The Evaluation of a One-Year Course, the Fusion of Physics and Chemistry with Other Physical Science Courses." Science Education 29:70-5. June 1945.

Pontius, John. A Survey of the Training and Methods of Teaching General Science. Master's thesis. Muncie: Ball State Teachers College. 1949.

- Powers, S. Ralph., "Programs for the Education of Science Teachers in State Teachers Colleges." A Program for Teaching Science. Thirty-first Yearbook, NSSE, Part I. Bloomington, Illinois: Public School Publishing Co. 1931. pp. 324-44.
- Prall, Charles E. and Cushman, C. Leslie. Teacher Education in Service. Washington, D. C.: American Council on Education, 1944. 503 p.
- Prall, Charles E. State Programs for the Improvement of Teacher Education. Prepared for the Commission on Teacher Education. Washington, D. C.: American Council on Education. 1946. 379 p.
- Preliminary Report of the Cooperative Committee on Science Teaching. "The Preparation of Science Teachers." School Science and Mathematics. 42:636-50. October 1942.
- Progressive Education Association. Commission on Secondary Curriculum. Science In General Education. New York: D. Appleton-Century Co. 1938. pp. xiii plus 591.
- Pruitt, Clarence M., "Science Teaching in the High Schools of Oklahoma." Science Education. 27:122-126. December 1943. (Reviews studies made by James W. Payne, Argus F. Smith, Sister Mary Lawrence Franz, and Olen M. Self.)
- Raths, Louis, "Dangers of Appraising Teacher Efficiency." School Executive 67:55-6. April 1948.
- Remmers, Henry Herman, Martin, F. O., and Elliott, D. N. Are Students Ratings of Instructors Related to Their Grades? Unpublished Study. Purdue University. 1949.
- The Report of the United States President's Commission on Higher Education. "Staffing Higher Education." Washington, D. C.: Superintendent of Documents, G. P. O. 1947. 63 p.
- Review of Educational Research. 21:253-4. October 1951.
- Review of Education Research. 19: June 1949. pp. 185-90.
- Reynolds, William Nathan, "Laboratory Facilities and Procedures for Chemistry in the High Schools of North Carolina." Science Education. 25:89-93. February 1941.

- Richardson, John S., "Some Problems in the Education of Science Teachers." Science Education 29:249-52. December 1945.
- Richardson, John S., "A Proposed College Curriculum for the Education of Science Teachers." Abstract of Doctoral Dissertations No. 40. Columbus: Ohio State University Press, 1942. pp. 285-92.
- Riddle, Oscar and Others. The Teaching of Biology in Secondary Schools of the United States. The Committee on the Teaching of Biology of the Union of American Biology Societies. 1942. 76 p.
- Robertson, John C. A Critical Study of Curricular Reorganization in Ohio Secondary Schools. Doctoral thesis. Columbus: Ohio State University, 1946. 520 p.
- Rosenlof, George W. and Wise, Harold E., "Experimenting with a Course in Combined Physical Science." School Review. 46:346-56. May 1938.
- Rudy, Madeline, "Science Education for Elementary Teachers in Texas Teacher Training Institutions." Science Education. 25:267-73. October 1941.
- Rumble, Heber Eliot, "More Science Instruction?" Science Education. 33:32-40. February 1949.
- St. Lawrence, Francis James. The Use of Teaching Aids in Biology Textbooks. Doctoral thesis. New York: Teachers College, Columbia University. 1949. (Unpublished.)
- Sanford, Charles W., "High School Science and Mathematics--For Whom and For What?" School Science and Mathematics. 50:307-19. April 1950.
- Science Education. 31:199-261. October 1947. (Report of NARST Convention)
- Seagoe, May V., "Standardized Tests in the Pre-Training Selection of Teachers." Journal of Educational Research. 36:678-93. May 1943.
- Sinclair, Thomas J., A Report About Business Sponsored Teaching Aids. F. A. Orven Publishing Co., Dansville, New York. 1950. 113 p.

- Smith, Herbert, A., "A Determination of the Relative Effectiveness of Sound Motion Pictures and Equivalent Teacher Demonstrations in Ninth Grade General Science." Science Education 33:214-21. April 1949.
- Smith, Ida Townsend, "My Ideal Teacher." Science Education 33:122-3. March 1949.
- Snyder, Ernest E., "College Degree Requirements for Teachers of Elementary Science." Science Education 34:30-1. February 1950.
- Spore, LeRoy. An Investigation of the Trends in Science Education in the Secondary Schools of the United States. Unpublished study. Claremont, California: Claremont Graduate School. July 1949.
- Steelman, John R. Chairman. Manpower for Research. Volume 4 of Science and Public Policy, a Report to the President by the President's Scientific Research Board, Washington, D. C.: Supt. of Public Documents, G. P. O., 1947. 166 p.
- Stickler, W. H., and Powers, Philip N., "Why not Courses on Recent Developments in Science?" School Science and Mathematics 46:811-7. December 1946.
- Sutton, Traver C., "Teacher Failure in Science Teaching." School Science and Mathematics 44:549-53. June 1944.
- Symonds, Percival M., "Personality of the Teacher." Journal of Educational Research. 40:652-61. May 1947.
- United States Office of Education. Offerings and Enrollments in High School Subjects. Biennial Survey of Education in the United States, 1948-50, Chapter 5. Washington, D. C.: Supt. of Documents, G. P. O. 1951. pp. iii plus 118.
- United States Office of Education. Inquiry into the Teaching of General Biology, 1949-50. Printed Questionnaire. Washington, D. C.: U. S. Office of Education, G. P. O. 1950.
- Walter, Raymond L. A Cooperative Program for Student Teaching Involving a Private College and A City School System. New York: Teachers College, Columbia University, 1947. 197 p. (Doctoral thesis.)
- Walter, Raymond L., "A Student Teaching Program Designed to Bridge the Gap Between Theory and Practice." Science Education 33:375-8. December 1949.

- Watkins, Ralph K., "The technique and Value of Project Teaching in General Science." General Science Quarterly. 7:235-56. Also 8:311-41 and 387-422. May, 1923; November 1923; January 1924.
- Watkins, Ralph K. and Perry, Winifred. Teachers Handbook, Science in our Modern World Series. New York: The Macmillan Co. 1941.
- Watkins, Ralph K., "The Preparation of High School Science Teachers in Terms of the Market." Science Education 20:56-60. April 1936.
- Watson, Donald R., "A Comparison of the Growth of Survey Courses in Physical Science in High Schools and in Colleges." Science Education 24:14-20. January 1940.
- Watson, Donald R., "The Training and Experiences of Instructors in Survey Courses in Physical Science." Science Education 25:80-84. February 1941.
- Weaver, Edward K., Meeting the Needs of Negro Science Teachers in Alabama. Doctoral thesis. New York: Teachers College, Columbia University. 1947. (Unpublished.)
- Weaver, Edward K., "Using Community Resources in the Education of Negro Teachers." Science Education 32:16-24. February 1948.
- Winans, Ada E. and Jean, F. J., "The Educational and Professional Status of Science Teachers in the Public Schools of Colorado." Science Education 29:133-36. April-May 1945.
- Wise, Harold E., "Supplementary Contributions of Sound Motion-Pictures in High School Biology." Science Education 33:206-13. April 1949.
- Witherspoon, Gertrude. The Experiences of Beginning Teachers with Science in the Elementary School and their Implications for Teacher Education. Doctoral thesis. Stanford University. 1942. 310 p. (Typewritten.)
- Witty, Paul A., "Analysis of the Personality Traits of the Effective Teacher." Journal of Educational Research 40:662-71. May 1947.
- Wright, Audrey Adele. Science Courses Required of Prospective Elementary School Teachers. Masters thesis. Durham, N. C.: Duke University, 1941. 100 p. (Typewritten.)

Wright, Grace S., "Teacher Improvements, Policies, and Practices." School Life 30:21-4. May 1948.

Wright, William A. E., "Subjects Taught by Science Teachers in Third Class School Districts of Pennsylvania." School Science and Mathematics 45:45-53. January 1945.

Wright, William Albert Earl, "The Place of Industrial Chemistry in the Training of High School Chemistry Teachers." School Science and Mathematics 44:257-9. May 1944.

Yothers, L. R., "Science Teachers for the Future." Science Education 29:78-9. March 1945.

Zeller, Dale, (Director). A Guide for Exploratory Work in the Kansas Program for Improvement of Instruction. Topeka, Kansas: Kansas State Department of Education. 1937.
Pp. 1 plus 388.

AUTOBIOGRAPHY

I, Warren Maywood Davis, was born in Barnesville, Belmont county, Ohio, May 13, 1908 and received most of my elementary schooling in the Barnesville schools. I attended high school in Jerusalem, Ohio, and received a diploma from the two-year high school there in 1922. After one year in the Beallsville, Ohio, high school I received my final year of secondary schooling and a diploma from the Athens, Ohio, high school in 1924.

After two years of study at Muskingum College, New Concord, Ohio, I began teaching in the rural elementary schools of Belmont county. After teaching three years in the rural schools, I taught one year in the Belmont village schools, then moved to the Barnesville exempted village school where I was successively junior high school mathematics teacher, high school teacher of science, and junior high school and elementary school principal. During the ten-year period spent in the Barnesville schools, I received the Bachelor of Arts degree from Ohio University, Athens, Ohio, and with this degree completed in 1933, began work almost immediately on a Master of Arts degree which was granted by the Ohio State University in 1940.

In September, 1940, I moved to Steubenville as head of the science department of the city schools and began the first of the work on a doctoral degree at The Ohio State University. During the summer of 1942 I was called to duty with the United States

Signal Corps in radar engineering and later served as a commissioned officer with the United States Navy in the same general area of work.

Returning to the field of professional education in 1946 as principal of the Alliance, Ohio, high school, I have become successively director of secondary schools and assistant superintendent. The residence work for the doctoral degree was completed in 1949-50 in the area of science education, with minor fields in secondary education, elementary education, and teacher education.

My published work includes articles in state and national educational magazines including The Ohio Schools, The Maine Teacher, School Science and Mathematics, Science Education, and The American School Board Journal.

I am married, have one son, and at present am assistant superintendent of the Alliance, Ohio, public schools.