CURRENT PRACTICES OF TEACHING ELECTRICITY
IN THE INDUSTRIAL ARTS PROGRAMS IN THE
SECONDARY SCHOOLS OF TEXAS

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CURRENT PRACTICES OF TEACHING ELECTRICITY
IN THE INDUSTRIAL ARTS PROGRAMS IN THE
SECONDARY SCHOOLS OF TEXAS

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CHAPTER I

INTRODUCTION

Man has always depended upon various kinds of services for his well being. Earliest man found that with human strength he could use such things as rocks and clubs to kill animals for his food and clothing. He also learned to use a wooden pole as a lever to lift heavy objects, and later he fashioned a piece of tree-trunk into a wheel. Man's growth through the centuries has been promoted by the slow but endless process of development of his imagination and ability to discover and use the several kinds of energy about the earth.

Perhaps the greatest advances made by man regarding these developments and the uses of energy have been accomplished during the twentieth century through the development of a force called "electricity." Man has learned how to make, transmit, and use electricity for no less a medium than that of making it his servant, performing the endless numbers of jobs for which it has been harnessed.

This new form of power is used so extensively today that it would be difficult to imagine life without the wonderful feats electricity performs. In view of the fact that the services provided through the use of electricity are so vital
to everyone, it is believed that the subject of electricity as taught in the secondary schools of Texas deserves consideration as one of the units of learning commonly included in industrial arts.

Statement of the Problem

This study is an analysis of the current practices pertaining to electricity as taught in industrial arts programs in the secondary schools of Texas.

Purpose of the Study

The major purpose of this study is to seek answers to and information concerning the following questions believed to be pertinent to the problem as stated.

1. To what extent is electricity offered to students in the secondary schools of Texas as a phase of industrial arts?

2. What per cent of the secondary schools offer electricity as a phase of industrial arts?

3. What per cent of the students enrolled in the secondary schools of Texas take electricity?

4. What is the nature of the units of learning taught in electricity? What are their lengths?

5. Are the necessary instructional aids and equipment available for teaching electricity in the schools?

6. What types and amounts of current and voltages are most commonly used in teaching electricity?
7. Is the electricity that is taught centered around the project method of teaching?

8. What is the average number of students in a regular class in electricity taught in the secondary schools of Texas?

9. Were most of the equipment and instructional aids used for teaching electricity built in the local industrial arts shop or were they purchased already built?

10. Are present facilities considered adequate by teachers for teaching electricity?

11. What type of program is used most commonly for testing student achievement?

12. What are the future plans, if any, for increasing offerings in electricity in the secondary schools of Texas?

13. How many semester hours of college preparation has each teacher completed in the area of electricity?

14. If electricity is not taught as a unit, with what other industrial arts areas is it correlated?

15. Are there plans to include electricity in the curriculum in the secondary schools where it is not taught at the present time?

16. What are the major reasons given as to why electricity is not taught more frequently in the secondary schools?

17. Do the industrial arts teachers in the secondary schools of Texas believe that electricity should be taught
as a phase of industrial arts rather than as a part of a science class?

18. Are the units and processes most commonly taught in electricity in the secondary schools of Texas compatible with those recommended by various state departments of education?

19. Do the industrial arts teachers in Texas believe that they would have been better qualified to teach electricity if the teacher education institutions they attended had provided more opportunities for preparation to teach electricity?

20. Do the industrial arts teachers in the secondary schools of Texas favor the requiring by teacher education institutions of one or more courses in electricity for all industrial arts majors?

Source of Data

Data for this study were secured from bulletins and courses of study published by sixteen state departments of education and the department of education in the District of Columbia, from articles appearing in current educational magazines on the subject of electricity, from several unpublished master's theses, and from a questionnaire constructed and mailed to industrial arts teachers in Texas towns and cities with a population of two thousand or more. A total of 170 questionnaires were returned, 125 of which were
completed by persons teaching industrial arts in the secondary schools located in towns and cities in Texas with a population ranging from two thousand to one hundred thousand. Forty-five industrial arts teachers who taught in secondary schools located in cities with a population of one hundred thousand or more returned questionnaires.

Plan of Procedure

In planning this study the following procedure was used.

Chapter I introduces the subject, followed by a statement of the problem, the purpose of the study, the source of data, the plan of procedure, the definition of certain terms considered pertinent to the study, and some recent and related studies pertaining to the problem under study.

Chapter II treats the subject of electricity as a phase of industrial arts and of general education. Various recommendations by sixteen state departments of education are presented with respect to the units of learning suggested for electricity; the recommendations of other people working in the field of industrial arts and general education are also presented.

Chapter III presents data concerning electricity as it is taught in the secondary schools of Texas. Some personal opinions and comments taken from questionnaires returned by the industrial arts teachers participating in the study are also included in Chapter III.
In Chapter IV an analysis of the data concerning electricity as actually taught in the secondary schools of Texas is made in light of the recommendations of sixteen state departments of education and other recognized authorities.

Chapter V contains a summary, some conclusions based upon the findings of the study, and recommendations.

Definition of Terms

Some of the terms used in this study are defined as follows:

"Electricity" is defined as a form of energy generated by friction, induction, or chemical change, and as having magnetic, chemical, and radiant effects. It is a property of the basic particles of all matter consisting of protons and electrons which attract each other.

"A. C. or alternating current" is defined as an electric current which changes its direction of travel in a given number of cycles per second.

"D. C. or direct current" is defined as an electric current which travels in only one direction.

"Industrial arts" is defined as that phase of general education that provides exploratory experiences with tools, materials, equipment, processes, and problems of an industrial society.

The term "instructional aids" is defined as those devices which are used for instructional purposes in a given
subject. They may include such things as exploded drawings, test equipment, mock-ups, models, posters, and charts.

The term "secondary education" as used in this study refers to areas of work at the grade levels seven through twelve.

"Industrial arts as a phase of general education" may be defined as those industrial experiences which can and should be a functioning, coordinated part of the total educational program.

"Unit shop" is defined as an industrial arts shop with facilities for providing experiences in a single phase of industrial arts.

"General shop" is defined as an industrial arts shop with facilities for teaching a combination of industrial arts activities and pupil experiences in a variety of the various phases of industrial arts.

"Current practices" as used in this study refers to the methods, techniques, instructional aids, and facilities available and used in the organization and teaching of electricity as a phase of industrial arts in the secondary schools of Texas.

"Analysis" is defined as an examination of anything to distinguish its component parts, separately, or in their relation to the whole.
Recent and Related Studies

Research in this study revealed few studies that have been made in Texas pertaining to the teaching of electricity as a phase of industrial arts and of general education. Since World War II, however, some research pertaining to this subject has been completed.

Charles S. Greathouse made a study of the use of electricity in the rural areas of North Texas in 1949 to determine the need for offering a course in electricity as a phase of industrial arts for boys and girls living on farms and attending secondary schools in Texas.¹ During the same year, Wayne Matthews studied the development of industrial arts in secondary schools of Texas to determine the growth of various unit courses in industrial arts which included electricity.² In 1951, Hoyt G. Byrd studied the desirability of an electrical course in the Merkel High School.³ One year later, in 1952, Cecil Lee Briggs developed a detailed set of teaching aids for use in teaching electricity in secondary schools.


and in supplementing available textbooks. In 1952, James C. Ellis made a comparative study of the needs and interests of the students of two junior high schools in Dallas, Texas, in which the general subject of electricity was treated to a limited extent.

Some research studies involving electricity courses in industrial arts programs for secondary schools, in addition to the aforementioned, were found to be available from institutions of higher learning in other states. Some of these were as follows:

A study was made in 1935 at the University of Tennessee, Knoxville, Tennessee, by Hackman, entitled "Teaching Electricity on the Junior High School Level." In 1939, a similar study, "The Status of Practical Electricity in the High Schools of Northern California," was made by Brandstatt at Oregon State College, Corvallis, Oregon, and "Electricity

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for the Junior High School General Shop" was developed by Weaver at the University of Indiana, Bloomington, Indiana, during the year 1941. Each of the aforementioned studies will be presented and treated in greater detail in the following chapter. The recommendations and findings of each of the eight studies presented will be used in Chapter IV in which an analysis of the current practices pertaining to electricity as taught in the secondary schools of Texas is made.

8R. J. Weaver, "Electricity for the Junior High School General Shop" (Unpublished Master's thesis, University of Indiana, 1941).
CHAPTER II

ELECTRICITY AS A PHASE OF INDUSTRIAL ARTS

Growth

Current thinking concerning industrial arts as a phase of general education represents a marked advance over some of the ideas expressed half a century ago. Present-day offerings in industrial arts programs are many, and no limit is fixed as to the number of different areas of learning that may be included in a program. Boys and girls today are offered an opportunity to explore industry and thus tend to find their interests through industrial arts experiences.

In a study of the growth of industrial arts in the secondary schools in Texas from 1927 to 1948, Matthews found that with the restoration of better economic conditions following the depression years of the 1930's, the curricula in Texas schools underwent a period of change. New subjects were introduced, and some neglected fields of study were revived. From 1939 to 1948 the greatest growth of industrial arts in the secondary schools in Texas occurred.\(^1\) There appears little doubt that the area of electricity in industrial arts programs has been retarded as compared with some of the other areas, such as woodwork, metal work, and drawing.

\(^1\)Matthews, op. cit., p. 36.
Relative to the growth of electricity, Matthews noted that in most cases this phase of industrial arts was offered only in the larger high schools. After the introduction of the laboratory of industries plan of industrial arts in 1935, it is evident that many of the smaller schools took the opportunity to equip a general industrial arts shop for three or four different phases of industrial arts at almost the same cost as that of a shop equipped to teach only one phase, such as woodwork, metal, and drawing.2

Courses in electricity included house wiring and bell work. This, of course, was intended to give the students an understanding of the basic principles of electricity. Quite often the students were given instruction in what might be called household electricity, where they learned to repair electrical appliance cords, light switches, and broken wires. . . . From tabulations of affiliated units in electricity after 1935, when the laboratory of industries was approved for affiliation, there was a growth of 14 affiliated units of electricity by 1949 while as late as 1928, none had been offered.3

Since electricity has been taught as one of the phases of the laboratory of industries program as shown above, it appears logical that the percentage of students taking such courses would show a definite increase since 1935.

From the United States Government bulletin entitled Tennessee Valley Authority, the following facts were noted relative to the increase in the use of electricity in the Tennessee Valley:

2Ibid., pp. 52-53. 3Ibid., p. 54.
Based on research covering 125 counties in the Tennessee River watershed, it was found that in 1933, one farm in twenty-eight had electricity, while today seven farms out of eight are electrified. . . . The Valley's agriculture income rose 145 per cent for the entire Nation. Yet relatively small increase in income seems to have provided the basis for a relatively rapid rise in the level of farm-family living. The changing life of farm people in the region reflected in indexes of levels of living compiled by the Bureau of Agricultural Economics. The Valley index, while still below the United States average, has climbed at a faster rate. It has risen 130 per cent for the Valley, 122 per cent for the seven Valley States, and 63 per cent for the United States as a whole.

. . . While electricity has been brought to most farms in the Valley, farmers have learned more about the use of electric power in their homes than they have as a factor of production on their farms. There is a great need for continued research and education in the applications of electric power in farm production processes. . . .

One of the primary requirements of the region which must be met is the continued growth of power-generating capacity to meet electricity requirements as they arise. Over the past few years power supply in the region has been tight because of industry, business, homes, and farms in an expanding economy. It will not be until the spring of 1954 that a normal relationship between power supply and demand will be restored. 4

The foregoing data indicate growth in the demand for electric power in this country. These ever-growing demands have been brought about largely because of the universal development of hydro-electric stations, better illumination, the use of electricity as a source of power in industrial plants, and the use of electricity for pleasure and recreational purposes. The production of electricity increased

4Tennessee Valley Authority, Two Decades of Progress, pp. 9-11.
from 38,921 million kilowatts in 1919 to 85,402 million kilowatts in 1952,\(^5\) whereas The World Almanac for 1952 stated that the combined utilities and industrial production of electricity for 1950 showed a total of 388 billion kilowatts of electricity.\(^6\)

This constant growth in the production of electricity has had a very definite bearing upon industrial trades. Occupations that employ men who must be trained in the use of some form of electricity include automobile mechanics, electro-typers, radio and television station and service men, telegraph operators and linemen, power plant employees, electrical inspectors, city inspectors of electrical equipment, electrical apprentices, motor repair men, and general service men. Hackman believes that economic conditions have made it impossible for the average man to receive this specific type of training in the industry in which he works and that the city schools should offer some preparation through industrial arts classes, including some electrical courses in the curriculum.\(^7\)

Electricity has become one of the most widely used of all the various sources of power and energy, and since most all persons have always had this power to serve them, it is

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\(^5\) Hackman, op. cit., p. 30.


\(^7\) Hackman, op. cit., p. 41.
easy for them to take for granted the many services it performs. Electricity is indeed man's servant. Regardless of the manner in which one earns a living, as stated by Dragoo and Porter in their introduction to General Shop Electricity, whether a man is a farmer, doctor, lawyer, mechanic, machinist, baker, or butcher, he will have occasion to use electricity and electrical equipment.8

It is easy to see the growth of the need for qualified people to continue the work created by the constantly increasing demand for electric current. In order to illustrate how commonplace the use of electricity has become to public consumers, the following list of advertisements pertaining to better living through the use of electricity is given:

Electric Power Rated a 'Bargain' Due to Reduced Cost
Confidence of U. S. Housewives Won by Automatic Washers
Shave Device Use Increases
Electrical Gifts Both Pleasing and Practical
Lamps Engineered for Variety Duty
Electric Iron Buying Need
Color Trends in Appliances
Sewing Machines Do Almost Anything
Upright Freezers Growing More Popular
Electrical Appliances Aid Working Wives
Rural Power Increases Farm Leisure
Power Tools Aid Household
Television Makes Stride
Modern Appliances Require Good Wiring

8A. W. Dragoo and C. B. Porter, General Shop Electricity, pp. 5-6.
Maintenance Important
Ten Don't's for Safety9

Articles and advertisements of this nature indicate a need for consumer knowledge concerning the use of electricity, and it is reasonable to believe that each consumer of modern electrical household labor-saving devices would be better prepared to use and care for these devices if he had some preparation concerning the proper use of electricity. It appears that as a result of this growth industrial arts as a phase of general education needs to be broadened so as to include at least an introduction to electricity. Exploratory experiences at the junior high school level would serve as a prerequisite to advanced work if the boy or girl should desire further knowledge of the subject.

Perhaps many school administrators have not been fully aware of the needs for such a course and consequently have not attempted to inform themselves of this problem. In order to determine the recommendations of the various state departments of education concerning electricity as a part of the curriculum, it was considered advisable to contact each of the various state departments of education to ascertain what suggestions and recommendations had been made concerning the teaching of electricity as a phase of industrial arts.

9Daily Times Herald, Dallas, Texas, July 26, 1953, Section 6, pp. 15-17.
Recommendations of Various State Departments of Education

During the spring of 1953, the writer corresponded with the forty-eight state departments of education, seeking a copy of the course of study or industrial arts guide from each state. The following results were obtained.

Bulletins designed for industrial arts were received from sixteen states and the District of Columbia, each of which showed definitely that electricity was recommended as one of the phases of industrial arts for the secondary level. From fourteen state departments of education it was reported that a new study guide for industrial arts was being prepared or that an old one was being revised. It was reported from sixteen state departments of education that there was no state directive of any kind pertaining to an industrial arts program. Those individuals reporting for the majority of these sixteen state departments of education indicated, however, that each industrial arts teacher organized his own courses in accordance with the regulations of the local school. A report was not received from two state departments of education.

The California Committee on Industrial Arts Education stresses the acquisition of an appreciation for and an understanding of the part electricity plays in everyday living, the development of skill in the use of tools for simple electrical construction, safe work habits, and the ability
to make elementary electrical repairs around the home through an exploratory program. The Guide for Industrial Arts Education in California contains the following recommendations:

At Level II, particular attention is given to the development of an interest and an understanding in fundamental electrical principles and theory. Opportunity to develop additional skills is provided through the wiring of fundamental electrical circuits and the repair of household appliances. . . . Level III is devoted more to theory with a further insight into the occupational requirements and opportunities in the electrical trade, while at Level IV, students with a definite interest in electricity may elect it as a possible vocation and work to that end.

Opportunities for the study of electricity, ranging from an exploratory level to that of a vocational nature, as indicated in the foregoing, indicate the possibilities available for boys and girls who take the prescribed courses in electricity offered in the secondary schools in the State of California. Likewise, the State Department of Education in the neighboring State of Oregon recommends that electricity be taught at the junior high school level and that it be offered for a period of nine weeks. It further recommends that the contents be divided into manual activity for 80 per cent of the time, including demonstrations, and related study for 20 per cent of the time.

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11 Ibid., p. 25.

As to desired student changes in knowledge and behavior, some further comments were as follows:

This work will bring about a growing understanding of the uses and operation of home and commercial electrical equipment. Proper attitudes and procedures for safely handling electrical equipment will be developed by the student, and his understanding of appliances will make him a more efficient consumer. . . . At the tenth grade level, eighteen weeks in practical electricity is recommended. The course is considered basic for guidance in vocational or avocational choices relative to the electronics field.\textsuperscript{13}

Since the pattern of thought is similar in the recommendations of the state boards of education for these two Pacific coastal states, the recommendations of the State Board of Education in the plateau state of Utah were examined. From the \textit{Utah Industrial Arts Handbook}, Part One, the following statements were taken:

Electricity on the junior high school level should be taught with special reference to its use in the home. . . while in the senior high school, emphasis shifts from broad offerings in a variety of fields to more specialized work in fewer areas. . . . Teaching aids and devices should be used, some of which may have to be made in the shop, while others may have to be purchased.\textsuperscript{14}

Here again it is indicated that a course in electricity should begin at the exploratory level and should progress toward specialization in the upper grades of the secondary level of general education.

\textsuperscript{13}Ibid., pp. 10-28.

From among the North Central States, the State Department of Education of Minnesota requires electricity of all eighth-grade students, with a minimum of eighteen clock hours or a maximum of forty-five clock hours.\textsuperscript{15} Electricity is also offered as recommended electives in the ninth, tenth, eleventh, and twelfth grades in Minnesota. In North Dakota, the State Department of Education recommends that electricity be offered at the secondary school level in order to acquaint the student with its fundamentals and with its importance and application in everyday living activities.\textsuperscript{16} In Iowa, the State Board of Education recommends that the boys and girls of today have an opportunity to learn about electricity and its safe use as a part of their general education and that the experiences in this area provide them with an understanding of this great industry and with information that will aid them in the selection, care, and use of its many products.\textsuperscript{17}

In this age of technology, probably every person should have some understanding of what electricity can do for him, of how to select and install simple electrical equipment, and of how to operate and care for it. "The present problem is the education of people in the principles and applications of

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electricity," according to the Industrial Arts Guide published by the Missouri State Department of Education. This Guide implies further that

It is the purpose of a course in electricity to provide the student with an understanding of the basic principles and applications of electricity in the home, on the farm, and in industry. In view of the importance of this great force on American life, no secondary program can be considered adequate which does not provide for a systematic study of electricity and its uses. . . . Electricity is a complicated science and art, and no attempt has been made to deal with all phases of the subject, nor is any claim made toward its perfection. The course assumes a knowledge of common wood and metal working tools, materials and processes and is confined rather largely to a study of the basic principles and applications of electricity. It is proposed that this course in electricity follow a comprehensive course in general shop or courses in wood and metal. It should probably be placed in the tenth or eleventh grade, although local conditions may suggest a different grade placement. Recommendations include that it be offered for one unit of credit and that the class meet five sixty-minute periods per week for a regular session of nine months.

In order to simplify the learning process for boys and girls who take work in electricity, other work areas, such as woodwork and metal work, may be associated with the area of electricity as recommended above by the State Board of Education of Missouri.

The Oklahoma State Department of Education, in a publication entitled Industrial Arts Bulletin Number 105, recommends

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19 Ibid., p. 8.
that electricity be offered from six to nine weeks on an exploratory basis at the junior high school level.20 As a part of the general education program, the Oklahoma State Department of Education maintains that industrial arts will play a vital role in the preparation of the youth in the senior high school. It also suggests that although electricity may be an elective subject, it is of such fundamental importance that no high school should consider its program as being up to standard unless several units of industrial arts are offered.21 Electricity was among those subjects suggested as a part of the total curriculum.

Industrial arts bulletins were received from the state departments of education of four southern states, namely, Louisiana, Mississippi, Florida, and Texas. The notations which follow will be stated in the same order.

The Louisiana State Department of Education recommends four courses in electricity for the secondary school level. Each course represents work for one semester, and the class periods are for one hour daily, with two periods per week being devoted to laboratory work, two periods to lecture work, and one period to related drawing. The maximum number of students recommended per class is twenty-four. These

20Oklahoma State Department of Education, Industrial Arts in Oklahoma, Bulletin No. 105, 1951, p. 36.

21Ibid., p. 37.
courses may be taken each semester and represent one unit of credit.22

In the State of Mississippi, the State Board of Education recommends that electricity be taught in a composite general shop program for the upper level of the junior high school grades.23 A somewhat broader program is recommended by the Florida State Department of Education in its Guide to the New Technology in Industrial Arts.24 This Guide places the study of electricity for the junior high school level in a particular segment of industry designated as "power." In this respect, electricity is taught as an exploratory unit in Florida. At the upper level of the secondary education program in Florida, electricity is considered of primary importance according to the needs of individual students.25

At the request of the Texas Education Agency a tentative bulletin for industrial arts in Texas has recently been prepared by an advisory committee; this bulletin is entitled Planning, Organizing, and Teaching Industrial Arts.26 From

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25Ibid., p. 58.

26Texas Education Agency, Advisory Committee for Industrial Arts, Planning, Organizing, and Teaching Industrial Arts, Tentative Bulletin in Preparation, Section III, p. 3.
In this bulletin the following recommendations were noted:

It would be impractical to set forth or to recommend a particular type of program with reference to the size of an industrial arts shop, equipment, and curriculum pattern because the various school communities and systems in the State of Texas range from one extreme to the other with respect to scholastic population, community needs, and interest.

The small exploratory shop including a number of selected activities for both the junior and senior high school levels may fulfill the needs in one community but be inadequate for another. In some school communities it may be more desirable to plan and equip a general exploratory shop for junior high school use, and a shop planned and equipped on the unit basis for senior high school use.

The type of industrial arts shop and curriculum content in a school community or system should be determined by the objectives to be achieved, the size and needs of the community school, the age and interests of the students, and the means available for organization, administering, and implementing a successful program.27

It was further suggested in the above-mentioned bulletin that units of learning in electricity for Level II, grades seven to nine, should be exploratory in nature and may be taught either as a unit correlated with woodwork and metal work or as a distinct phase of the general industrial arts shop program for a period of time ranging from six to nine weeks. Suggestions with respect to the processes, technical information, and related information to be included are as follows:

A. Processes
   1. Laying-out and making simple wiring circuits

27Ibid., p. 4.
25

2. Skinning and splicing wires
3. Soldering and taping
4. Making electrical connections
5. Tying underwriter's knot
6. Coil winding
7. Testing

B. Related and Technical Information
1. Magnetism
2. Currents and voltages
3. Conductors and insulators
4. Sources and types of current
5. Circuits
6. Use and care of motors
7. Fuses and cut-outs
8. Figuring costs
9. Safety practices
10. Terminology
11. Occupational information and job opportunities
12. Local enterprises
13. Communication
14. Miscellaneous home repairs

The foregoing phase of industrial arts provides opportunity for the development of an exploratory unit of learning for the junior high school pupil, and it can be correlated quite advantageously in a general industrial arts program with other basic areas. The teacher should plan and develop the unit around the interests and needs of the students and around the facilities available for presenting it.

Recommendations concerning units of learning in electricity for Level III, grades ten to twelve, are as follows:

Objectives suggested for planning and developing units of learning in electricity for Level III, grades ten to twelve, will be the same, regardless of the size of the school system. The units of learning in electricity will continue to be exploratory, but more advanced in nature than at Level II.

Ibid.
If specific unit courses are organized and taught in the electrical area, they should be more technical, with emphasis on opportunities for experimentation on those phases of their greatest interest, according to the desires and needs of the students. 29

It appears that the above recommendations, as suggested by the Advisory Committee of the Texas Education Agency, represent current thinking concerning modern trends by recommending that electricity be included as a phase of industrial arts.

The Board of Vocational Education, Springfield, Illinois, in a bulletin entitled The Industrial Arts General Shop, shows that at present there are nine different areas included in various general shop programs in the State of Illinois. Electricity is one of these, and it is recommended in six of the several suggested courses recommended by the Illinois Department of Industrial Education. 30

Since Indiana and Ohio are in the same general geographical area as is Illinois and since all of these states engage in both agriculture and manufacturing on a large scale, it is interesting to note the similarity in the recommendations of the state departments of education for teaching electricity as a phase of industrial arts. The State Department of Education in Indiana recommends in its bulletin

29 ibid., p. 31.

entitled *Electricity for General Shop* that a particular book should be used as a text in following the suggested outline.\(^{31}\) This bulletin suggests that *Fundamental Jobs in Electricity* by Edgar C. Perry and Harry V. Schafbrook be used. Several other books are also suggested as supplementary texts to be used in teaching electricity. The recommended outline represents the minimum content that should be covered in the eight weeks allotted to teaching electricity. Teaching aids are recommended for the presentation of content, along with sources of help in the local community.\(^{32}\)

The state of Ohio ranks second in the nation in the electrification of farms, and Texas ranks first in the electrification of farms.\(^{33}\) This fact alone should justify the inclusion of exploratory experiences in electricity as one of the major areas in the industrial arts program in the public schools of Ohio and of Texas.\(^{34}\) The interest of many people in electricity as a science, the curiosity of others in knowing how it works, and the conveniences it brings to the modern home in everyday living indicate the possibilities for developing a valuable and fascinating area of instruction.

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\(^{32}\) Ibid.

\(^{33}\) *Ohio State Department of Education, Suggested Outline of Syllabus for Electrical Unit*, 1953, p. 3.

\(^{34}\) Ibid.
The Suggested Outline of Syllabus for Electrical Unit published by the Ohio State Department of Education explains further that:

No attempt has been made to outline a program by grade level. Electricity is the one area of our Industrial Arts program which in order to progress must be developed from the basic fundamentals. Up to a certain point the program can be developed with a minimum of equipment and at not too great a cost. However, in order to develop more than an elementary unit, it becomes necessary to provide more technical equipment and more technical material. Electricity in the seventh and eighth grades will be exploratory. For those school systems with adequate facilities a unit type of organization is recommended. For those in the upper high school levels, emphasis is placed upon skills and opportunities for experimentation on those phases of their greatest interest.35

The only industrial arts bulletin received from the New England States came from the Maine State Department of Education and is entitled Industrial Arts in the State of Maine.36 Recommendations in this bulletin pertaining to teaching electricity are as follows:

The Maine State Department of Education recommends that the areas of activity in industrial arts include: woodwork, metal work, electricity, and internal combustion engines. This department strongly urges that all programs in industrial education on the secondary level provide those pupils participating with a work period equal to two regular class periods daily five days per week.37

35Ibid., p. 4.
37Ibid., p. 10.
It appears evident from the recommendations made by the various state departments of education, as partially presented in the foregoing paragraphs, that they are in agreement in their thinking that electricity is necessary as a regular unit course or as a part of a general industrial arts program at the junior high school level. These departments also agree that advanced courses in electricity should be made available to students in high schools as the need arises. Although several of the state departments of education did not furnish industrial arts bulletins or study guides, as stated at the beginning of this chapter, it was reported by a large per cent of the state departments of education that they were working on new industrial arts bulletins or were attempting to revise old ones. In most of these communications it was stated that future bulletins would include recommendations to the effect that a course in electricity should be included in industrial arts at the secondary level.

Recommendations of Persons Representing Industry

Since it was impossible to secure counsel from all persons considered as authorities on the subject of electricity as a phase of industrial arts, it was deemed important to include suggestions and recommendations of some of the individuals who have written articles, books, and bulletins pertaining to electricity as a phase of general education. One can see
that the daily life of practically every individual involves the use of electricity in some way. Nevertheless, the popular concept persists that its operation is a great mystery and is beyond the reach of the untrained layman. This is mentioned in the introduction to a booklet issued by the National Carbon Company entitled Fun with Dry Batteries.38 This booklet also states that in these days of the widespread use of electricity, everyone should know the fundamentals of its operation.39

Over a period of eight years prior to 1935, Hackman taught electricity as a regular unit of work in the Park Junior High School at Memphis, Tennessee, and during that time he made the following observations:

The demand for better trained workmen in the field of electricity was being evidenced at that time due to development of electrical distribution systems with lower rates, and that many men would be needed as engineers, salesmen, servicemen, maintenance and repair men. These men would have to be trained in some phase of electrical occupation which this undertaking creates. In an ideal situation, some agencies should instruct boys who have a possibility of success in the field.40

This observation indicates a need for at least some kind of a program in industrial arts that would include electricity at the secondary level. In conclusion, Hackman supported this need as follows:

38 National Carbon Company, Fun with Dry Batteries, p. 5.
39 Ibid.
40 Hackman, op. cit., pp. iii-iv.
A course in electricity is feasible on the junior high school level in that there is sufficient amount of content to be learned and a sufficient number of jobs to be performed which are within the capacity of the average pupil. Since it has been found that 85 per cent of the city homes in the United States are electrically equipped, Boards of Education are justified in having electrical work taught as a regular industrial arts subject in the school curriculum. . . . Such a course in the junior high school serves as a splendid opportunity for the instructor to select those boys who are the most capable in this field with a view toward counseling them to pursue additional training in electricity. . . . While the electrical courses in the junior high school are not vocational in the sense that adequate preparation is given to secure a job as an electrician, there is a great deal of fundamental electrical knowledge which could be taught that would be an asset to a boy who desired to secure a job in the electrical field.41

Not only is the need apparent that boys should be allowed to explore the fundamentals of electricity in a general education program, but girls also should be given similar opportunities to study electricity in order that they might become more enlightened as a consumer about how to use and care for ordinary household appliances and the like. In a recent newspaper article, Margaret Kane described the knowledge of the average housewife concerning her ability to use and care for modern electrical gadgets, which adds emphasis to the above suggestion by Hackman, when she said:

What the average woman knows about electricity is limited to the fact that by pushing a button she can turn on a light, start a vacuum cleaner or toaster. When something goes wrong, she remains in

41 Ibid., pp. 118-120.
the dark, both figuratively and literally. . . .
Without attempting to become electricians, however, every woman should know about the wiring of her home and about her electrical appliances.42

In a book entitled *Fundamentals of Applied Electricity*, Jones also emphasizes that girls, as well as boys, should know something about the subject of electricity.43 This fact is evidenced by the following paragraph:

With millions of electrically operated labor-saving devices in American homes and the number increasing at a rapid rate, there is a sensible need on the part of every boy and girl to know something about the construction, operation, and care of household appliances and of the circuits which serve them.44

Jones presents the simple fundamental working principles of electricity and magnetism through description, picture, example, and demonstration. The material was presented around the central idea that the teaching of elementary electricity should be based upon practical applications that meet a common need, thus giving a working knowledge of ordinary, everyday electricity. Jones also mentions that numerous field trips, the demonstration of important principles by experiment, and the building of typical devices in the shop serve through active student interest and participation to fix the essential facts in the learner's mind.45

42Margaret Kane, "Housewife Needn't Be in Dark about Electric Wiring Gadgets," *Dallas Morning News*, November 2, 1953, Section III, p. 1.

43E. W. Jones, *Fundamentals of Applied Electricity*, p. 188.

44Ibid.

From recent studies made at North Texas State College, Denton, Texas, the University of Indiana, Bloomington, Indiana, and the Oregon State College, Corvallis, Oregon, additional information that emphasized the need for adding a course in electricity to the present program of industrial arts in secondary schools was secured for this study. Greathouse made a study concerning the use of electricity in rural areas in North Texas and noted the following:

A precedent for the expenditure of public funds to teach electricity in our public schools has already been established in the larger school systems of Texas. The rural families living on electrified farms in the North Texas area want instruction of this type given to the boys and girls in their communities, and both the rural people and the professional people interviewed in the North Texas area believe that instruction dealing with the use of electricity and electrical equipment should be included as a part of the curricula of our public high schools, and that these schools should assume the responsibility for fulfilling any indicated needs.46

From the foregoing statements it is evident that families who live in rural areas of North Texas are of the opinion that a course of instruction dealing with the use of electricity should be included as a part of the curricula of the public schools and that it should be available to both boys and girls.

The needs and interests of junior high school boys and girls in Dallas, Texas, were studied by Ellis. This investigation indicated a need for both radio and electricity

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courses at the elementary level in the junior high school. Recommendations by Byrd indicated that an electrical course for the secondary school level should be planned around the interests and needs of the students for consumer education purposes in electricity, for vocational education in electricity, and as a hobby, and that such a course should be available to both boys and girls.

In an investigation for the purpose of developing teaching aids to be used in elementary electricity courses in industrial arts at the secondary school level, Briggs found that in many schools the courses planned and taught in elementary electricity had little relationship to similar courses in other schools. Books in the area of electricity were also compared, and although no two books treating elementary electricity agreed completely as to what should be taught in an elementary electricity course, there was a greater degree of agreement among the contents of these texts than was found in the many courses of study that were examined. This is in agreement with what the writer found with respect to prepared courses of study and study guides for industrial arts compiled by the various state departments of education and presented earlier in this chapter.

47Ellis, op. cit., p. 80.
48Byrd, op. cit., p. 46.
49Briggs, op. cit., p. 8.
While at the University of Indiana, Weaver wrote a course of study for teaching elementary electricity in the junior high school shop. He departed from the established precedent in that the course of study did not consist solely of the usual bell-and-buzzer wiring exercises frequently included in the section on electricity in the general industrial arts shop organization. Work of a more practical nature was suggested which would not only appeal to the boys taking the course but would also create a desire on the part of the student for further instruction on the subject. The course developed by Weaver was introduced and taught in the ninth grade at the Washington High School at Indianapolis, Indiana.50

Brandstatt made a study to determine the type of instruction, desirability, and extent to which practical electricity was being used as a shop subject in the high schools of northern California.51 He used the normative survey and from its results ascertained, in part, the following:

The results of this study seem to indicate that practical electricity is a definite part of the industrial arts program in the majority of high schools of Northern California. There is general agreement that electricity compares favorably with other shop subjects in popularity among students. It also appears evident that a course in electricity would materially improve the industrial arts program of the school where it is not now a

50Weaver, op. cit., pp. 9-10.
51Brandstatt, op. cit., p. 55.
shop activity. . . . Practical electricity has a
definite place in the industrial arts program. In
schools where electricity is not offered, a def-
inite course in electricity should be organized and
made a part of the industrial arts program or as
part of the general shop subject matter.52

It is evident from the foregoing statements that some
persons who are interested in teaching electricity believe
that they can foresee what might become a trend in future
courses in electricity. This trend seems to point toward a
course in electricity constructed on a more practical ap-
proach than some of the courses have proven to be in the
past.

Another opinion concerning such a trend in electricity
courses was that of Frank C. Moore, Director of Industrial
Arts, Cleveland, Ohio, who commented as follows:

I rather hesitate to approach this subject
of electricity because I have seen it in so many
different ways in industrial arts shops through-
cout the country. I think the trend will be toward
general electricity but not bell wiring and splic-
ing as exercises. I believe that bell wiring and
splicing go back toward the old-time manual train-
ing instead of ahead toward the new industrial arts.

I think the emphasis will be on the making of
projects--boy projects, interesting projects, prob-
lems requiring that the fundamentals of electricity
be used in correlation with wood and metal--so that
when the boy has finished a given project, it fills
a need for him.

In electricity, as in many other fields, we
have chosen projects from the adult standpoint
rather than from the viewpoint of the boy himself.
We must remember that boys are interested in shock-
ing machines, in crystal radios, in motors if they
actually run something--but not in motors themselves.

52 Ibid.
We must realize that in this field, as in all other fields, boy interest, boy aptitudes, and boy abilities are the controlling factors when it comes to the selection of projects to be covered.53

It is easily understood, as noted in the above comments, that electricity courses must evolve from the so-called manual training era of subject matter.

Further suggestions concerning this trend in the teaching of electricity were made by Pawelek in a recent article entitled "Teaching Electricity."54 It is Pawelek's opinion that to learn a few principles well is educationally more sound than to memorize many facts. After trying various teaching devices he concluded that one of the most valuable teaching aids to instruction in electricity is the demonstration panel consisting of several different kinds of circuits, thus overcoming one of the most frustrating experiences in teaching electricity. He used lettered cards attached to the front of the testing devices explaining the functions of each circuit and explaining the various ways in which it could be set up for problem situations. Pawelek also believes that a fundamental knowledge of practical electricity may be taught through the wise use of similar teaching aids.

53P. C. Moore, "Trends in Industrial Arts Education," Industrial Arts and Vocational Education, XXVIII (April, 1939), 137.

thus gaining at least a slightly above-average course content and presentation technique.55

Remarkable as present achievements are in the field of electricity, there is little doubt that future developments will show that today man has barely tapped its possibilities. Irrespective of the future, the individual living in present-day environment will be handicapped unless he is reasonably well informed concerning the many electrical applications in daily living. Thus, it appears that through industrial arts programs a great contribution can be made toward the general education of all children in the area of electricity. Individuals vary considerably, however, in their aptitudes and interests for the different industrial arts areas, and the area of electricity is no exception. Some problem areas which illustrate the diversity of possible interest pointing toward the over-all objectives of industrial arts are listed in a bulletin entitled A Guide to Improving Instruction in Industrial Arts issued by the American Vocational Association. Included in the bulletin is the following list of areas of probable interest:

- Having fun with electricity
- Repairing home appliances
- Development of an amateur radio station
- Study about automobile electrical systems
- Building a radio receiver
- Operating an electric train
- Farm improvement with electricity
- Rewinding motors

55Ibid.
Making electric toys
Making motion type displays
Industrial tours56

Manufacturing processes and technical information which should be stressed in teaching a course in electricity are also recommended in the bulletin as follows:

A. Processes
1. Experimentation and development
2. Planning
3. Safe practices
4. Use of tools and equipment
5. Insulating techniques
6. Coil winding
7. Wiring techniques
8. Circuit analysis
9. Repair of electrical equipment
10. Power installations

B. Technical Information
1. Occupational information
2. Consumer knowledge
3. Health and safety
4. Understanding industry
5. Nature of electronics
6. Types of circuits
7. Measuring devices
8. Application of electrical principles57

From the foregoing information it is obvious that those individuals of the American Vocational Association who participated in writing the Guide to Improving Instruction in Industrial Arts accepted about the same objectives for industrial arts in the program of general education as did the members of various state departments of education who had prepared study guides and bulletins for industrial arts.

57Ibid., pp. 64-67.
It does not seem wise to close Chapter II of this study without quoting from an article by Marshall L. Schmitt in which he states as follows:

The industrial arts shops that include electricity as a part of their curriculum and utilize its possibilities to a high degree are contributing to the over-all objectives of education, and the shop which does not include electricity in the program cannot possibly fulfill its many obligations to the students who are in attendance and are to be educated for the way of life in which they will find themselves compelled to make a living.\(^\text{58}\)

This statement is not only a recommendation that electricity should be offered to industrial arts students as a phase of general education, but it also infers that to fulfill such a program is obligitory.

**Summary**

After a study had been made of the various bulletins received from the state departments of education and of the research completed by Briggs, Matthews, Hackman, Greathouse, Ellis, Byrd, Weaver, and Brandstatt, it was found that there was much similarity and agreement in the recommendations set forth concerning the need for including electricity in the school curriculum.

With respect to the grade level at which electricity should be taught, it was recommended that electricity should be taught at the junior high school level, grades seven to

nine, by fourteen different state departments of education. Sixteen of the states recommended through their official bulletins that electricity should be taught also at the high school level. Briggs, Ellis, Hackman, and Weaver, as a result of their studies, recommended that electricity should be included in the curriculum for junior high school students, whereas Greathouse, Byrd, and Brandstatt made generalizations that electricity should be planned in the secondary school around the interests of the students.

In bulletins published by nine state departments of education it was recommended that electricity should be offered for a period of time ranging from six to eighteen weeks as a regular unit course. In other bulletins no suggestions were made as to the number of weeks a course in electricity should be offered. Suggestions in 75 per cent of the bulletins received from the various state departments of education implied that electricity should be taught as an exploratory unit at the junior high school level. Other recommendations indicated that electricity should be carried over into the high school level on an exploratory basis, followed by more advanced work on the unit plan as the need arose. Briggs, Brandstatt, Byrd, and Ellis also indicated that electricity should be offered in junior high schools on an exploratory basis.

Specific areas with which electricity should be correlated in general industrial arts programs mentioned in the
state bulletins included woodwork, metal, and drawing. Mention was also made in one state bulletin that the number of students in a class in electricity should not exceed twenty-four. Another state department of education proposed in its bulletin that a particular textbook be used in connection with the course in electricity. Briggs found in his study, however, that no two books treating elementary electricity agreed completely as to what should be taught in an elementary electricity course.

In two state bulletins it was found that teaching aids were recommended for the presentation of the content in a course in electricity along with sources of help usually available in the local community. Jones mentioned that numerous field trips, the demonstration of important principles by experiment, and the building of typical devices in the shop serve through active student interest and participation to fix the essential facts in the learner's mind. After making an investigation with respect to the needs of instructional aids in electricity courses, Briggs not only recommended their use but developed a group of aids including such items as exploded drawings, test equipment, mock-ups, models, charts, posters, and panels.

The suggestions included in the state bulletins used in this study concerning the projects most generally used in

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teaching electricity tend to follow a pattern similar to that in a bulletin published by the Missouri State Board of Education which suggested as follows:

Projects in electricity should provide for four types of activity on the part of the student: (1) purpose, (2) planning, (3) execution, and (4) judging or evaluation. Besides providing these four types of student activity, projects should conform to these criteria: (1) They should include some of the things to be taught in the course; perhaps a small number of units in the first project should be included and larger numbers as the student progresses. (2) They should interest and challenge the student, and yet be within his range of ability. (3) They should be well designed, and, if possible, have practical use when completed. (4) They should be suited to school shop conditions—tools and materials available, and cost. (5) They should be of such a nature that the student can complete them in a reasonable time and should lead on to other worthwhile projects.61

Research also revealed that the amount of floor space occupied by industrial arts classes should range between 50 square feet and 125 square feet per pupil, depending upon local conditions, such as the courses offered, the grade level, the size of the class, and the extent of concentration desired.62

The bulletins suggested the correlation of electricity with other subject matter areas, such as English, mathematics, and social studies. These suggestions appear to coincide with those set forth in the tentative bulletin of the Texas


Education Agency which concluded that a course in electricity can be correlated quite advantageously in a general industrial arts program with other basic areas and that the teacher should plan and develop the unit around the interests and needs of the students and around the facilities available for teaching it.

From the foregoing it is evident that the uses of electricity are definitely increasing in this country from year to year. It is also evident that the various state departments of education recommend that courses in electricity should be offered to boys and girls as a phase of industrial arts in secondary education. The data taken from the questionnaires returned by 170 industrial arts teachers participating in the study and pertaining to the current practices with respect to electricity as it is taught in the secondary schools of Texas will be presented in Chapter III.
CHAPTER III

PRESENTATION OF DATA CONCERNING ELECTRICITY

AS TAUGHT IN THE SECONDARY SCHOOLS

OF TEXAS

In order to conduct the study it was necessary to obtain a mailing list of industrial arts teachers in Texas. The Texas Almanac\(^1\) was used to obtain a list of the cities and towns having a population of two thousand or more. Letters soliciting a roster of industrial arts teachers were mailed to superintendents or industrial arts supervisors in each city or town with a population of two thousand or more. The names and addresses of 518 industrial arts teachers were received in answer to this request. Of the 518 industrial arts teachers reported, 261 were employed in schools in the larger cities in Texas, such as Houston, Dallas, San Antonio, Fort Worth, El Paso, Corpus Christi, and Austin; the remaining 257 industrial arts teachers were employed in school systems of cities and towns having smaller populations.

Rosters of industrial arts personnel received from superintendents or industrial arts supervisors of the larger city school systems indicated that electricity was taught to

\(^1\)Texas Almanac and Industrial Guide, 1953.
a limited extent in the majority of these school systems by only a few industrial arts teachers, each of whom was sent a questionnaire. Questionnaires were also sent to each of those persons teaching industrial arts in school systems of cities and towns in Texas having smaller populations than the larger cities mentioned above.

The questionnaire was arranged in two parts; one part was designed to secure data and information concerning electricity taught in the secondary schools, and the other part was designed to secure data and information from those schools in which no electricity was offered. A copy of the questionnaire may be found in the Appendix. The questionnaires which were returned indicated that electricity was actually offered in only forty-two schools as a phase of industrial arts. The other 128 questionnaires which were returned were from schools in which no electricity was offered as a phase of the industrial arts program. For the sake of simplicity hereafter, the forty-two schools in which electricity was taught will be referred to as group "A," and the 128 schools in which no electricity was offered will be referred to as group "B."

Electricity as a Phase of Industrial Arts in Forty-Two Schools

Data received from the forty-two schools included in group "A" disclosed that electricity was offered to students
at the junior high school level in the seventh, eighth, and ninth grades by 83 per cent of the schools. The data showed also that 38 per cent of the forty-two schools were offering electricity to students at the high school level in the tenth, eleventh, and twelfth trades. Electricity has been offered in 30 per cent of these forty-two schools for a period of time ranging from ten to fifteen years, and in 70 per cent of the schools the time ranged from one to nine years. It was revealed that electricity is being offered as a regular unit course on the semester basis by 24 per cent of the schools; in 67 per cent of the forty-two schools, electricity was taught for a period of time ranging from six to nine weeks. In two questionnaires returned it was indicated that electricity was taught for four weeks only.

Electricity was reported as being taught on the unit plan in ten of the schools and was included in a general shop plan in thirty-two of the schools, according to the questionnaires representing the schools included in group "A."

Table 1 contains data showing the various phases of industrial arts with which electricity is most often correlated, according to the teachers reporting for the forty-two schools included in group "A." The data show that the number of students in a regular class in electricity ranges from six to thirty in the schools included in group "A."
TABLE 1

DATA CONCERNING THE PHASES OF INDUSTRIAL ARTS WITH WHICH ELECTRICITY IS CORRELATED IN FORTY-TWO SCHOOLS

<table>
<thead>
<tr>
<th>Areas with which Electricity Is Correlated</th>
<th>Number of Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodwork</td>
<td>30</td>
</tr>
<tr>
<td>Metal work</td>
<td>30</td>
</tr>
<tr>
<td>Crafts</td>
<td>14</td>
</tr>
<tr>
<td>Drawing</td>
<td>26</td>
</tr>
<tr>
<td>Others</td>
<td>5</td>
</tr>
</tbody>
</table>

In fifteen of these schools; or 35.71 per cent, the number of students in a class in electricity ranged from six to fifteen; in twenty-seven of the schools, or 64.28 per cent, the number of students in a class in electricity ranged from twenty-one to thirty. It was also found that a particular textbook was used in electricity courses offered in nineteen of the schools, whereas according to a response received from twenty-three of the schools, no particular textbook was being used. General Shop Electricity by Dragoo and Porter appeared to be the favorite textbook in fourteen of the schools in which a particular textbook was reported as being used.

Instructional Aids Available for Use in Teaching Electricity

The extent to which instructional aids were reported as being available and as being used in teaching courses in
electricity in the forty-two schools included in group "A" is indicated in Table 2.

TABLE 2

INSTRUCTIONAL AIDS AVAILABLE FOR USE IN TEACHING ELECTRICITY IN FORTY-TWO SCHOOLS

<table>
<thead>
<tr>
<th>Type of Instructional Aid</th>
<th>Number of Schools in Which the Aid Is Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploded drawings</td>
<td>28</td>
</tr>
<tr>
<td>Testing equipment</td>
<td>36</td>
</tr>
<tr>
<td>Mock-ups</td>
<td>19</td>
</tr>
<tr>
<td>Charts</td>
<td>25</td>
</tr>
<tr>
<td>Models</td>
<td>21</td>
</tr>
<tr>
<td>Posters</td>
<td>24</td>
</tr>
<tr>
<td>Panel displays</td>
<td>23</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
</tr>
</tbody>
</table>

As shown by the data in Table 2, exploded drawings, charts, posters, and panels designed to display various electrical equipment and supplies were most commonly used. The majority, thirty-six, of the schools owned equipment for testing purposes. The industrial arts teachers reporting for the forty-two schools included in group "A" indicated that pupils in electricity classes were allowed to experiment with alternating current ranging from six to 110 volts. It was noted, however, that in thirty-seven of the forty-two schools, students were allowed to experiment with alternating current ranging
up to a maximum of 110 volts, and in thirty-eight of the schools, students were allowed to experiment with direct current up to a maximum of twenty-four volts. It was also indicated that a specific number of projects was required of each student taking electricity in eighteen of the schools, whereas in the other twenty-four schools, no certain number of projects was required of each student. In thirty-nine of the forty-two schools in group "A," students who take electricity are encouraged to develop projects that involve work in other areas of industrial arts.

Types of Tests Used by Teachers of Electricity in Forty-Two Schools

The types of tests most commonly used for evaluating the student's work in electricity in the schools included in group "A," as shown by the questionnaires returned, are listed in Table 3.

**TABLE 3**

**TYPES OF TESTS USED BY TEACHERS OF ELECTRICITY IN FORTY-TWO SCHOOLS**

<table>
<thead>
<tr>
<th>Types of Tests</th>
<th>Number of Teachers Using the Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completion</td>
<td>37</td>
</tr>
<tr>
<td>True-false</td>
<td>23</td>
</tr>
<tr>
<td>Multiple-choice</td>
<td>29</td>
</tr>
<tr>
<td>Others</td>
<td>25</td>
</tr>
</tbody>
</table>
The data in Table 3 indicate that the majority of the teachers used some form of the objective type of test, such as the multiple-choice, completion, and true-false test. The data obtained from the questionnaire showed that most of the equipment available for teaching electricity was purchased ready-built by seventeen of the forty-two schools in group "A"; in the other twenty-five schools most of the electrical equipment was built in the industrial arts shop by the teacher and the students. Thirty-four of the industrial arts teachers indicated that their schools planned to acquire additional instructional aids and equipment for use in the teaching of electricity.

**Floor Space**

The amount of floor space available for use in teaching electricity ranged from 100 square feet to slightly more than 1500 square feet in the forty-two schools in which electricity was reported as being taught, as shown in Table 4.

**TABLE 4**

<table>
<thead>
<tr>
<th>DATA CONCERNING THE AMOUNT OF FLOOR SPACE AVAILABLE FOR USE IN TEACHING ELECTRICITY IN FORTY-TWO SECONDARY SCHOOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amount of Floor Space Available</strong></td>
</tr>
<tr>
<td>100 to 500 square feet</td>
</tr>
<tr>
<td>500 to 1000 square feet</td>
</tr>
<tr>
<td>1000 to 1500 square feet</td>
</tr>
<tr>
<td>1500 square feet or more</td>
</tr>
</tbody>
</table>
Eighteen of the shops were reported as having only between 100 and 500 square feet available for electricity. This small amount of space may be due to the fact that electricity is included in a general industrial arts program, and therefore only a small area is allotted for the teaching of this phase.

The data in Table 4 also show that only five schools were reported as having 1500 square feet or more of floor space for use in teaching electricity. In these schools electricity is taught for a period of eighteen weeks on the unit basis. Eleven of the teachers completing and returning the questionnaire stated, however, that it was the plan of their respective schools to provide additional floor space to be used for electricity in the near future.

One question appearing in the questionnaire was "In your opinion do you think laboratory experiences in electricity should be taught in a science class rather than as a phase of industrial arts?" Four teachers replied "Yes" in answer to this question, whereas thirty-one, or 74 percent, of the teachers answered "No," and seven teachers indicated that they believed electricity should be offered in both science and industrial arts courses. Another question requested information as to whether or not electricity and its use were taught or emphasized in other subject matter areas, such as English, mathematics, and social science. Replies to this question are shown in Table 5.
When an examination of the questionnaires was made, it was noted that in no instance was electricity reported as being taught in a science class. According to the data returned by the teachers, electricity was emphasized and correlated to a degree with English, mathematics, and social studies.

Since there is a possibility that some students might be excluded from taking electricity because of fear on the part of their parents, a question to that effect was included in the questionnaire. Negative answers came from 99 per cent of the replies to this question.

It was suggested by various state departments of education, as previously mentioned in this study, that certain processes and related information be considered and discussed in connection with the actual laboratory experiences and work in electricity classes. A list of the most commonly-mentioned processes and related information was included in the
questionnaire. Table 6 presents data which show the processes most commonly included in the units of learning designed for teaching electricity as a phase of industrial arts in the forty-two schools included in group "A."

**TABLE 6**

**DATA CONCERNING THE PROCESSES IN ELECTRICITY MOST COMMONLY TAUGHT AS A PHASE OF INDUSTRIAL ARTS**

<table>
<thead>
<tr>
<th>Processes</th>
<th>Number of Schools in Which the Process Is Taught</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making and Reading</td>
<td></td>
</tr>
<tr>
<td>Wiring Diagrams</td>
<td>38</td>
</tr>
<tr>
<td>Splicing</td>
<td>42</td>
</tr>
<tr>
<td>Use of Circuits</td>
<td>41</td>
</tr>
<tr>
<td>Use of Conductors and Insulators</td>
<td>41</td>
</tr>
<tr>
<td>Use of Fuses and Breakers</td>
<td>37</td>
</tr>
<tr>
<td>Use of Resistances</td>
<td>34</td>
</tr>
<tr>
<td>Use of Testing Equipment</td>
<td>37</td>
</tr>
<tr>
<td>Installation Processes</td>
<td>38</td>
</tr>
<tr>
<td>Uses of Electrical Measuring Devices</td>
<td>35</td>
</tr>
<tr>
<td>Use and Care of Common Household Appliances</td>
<td>36</td>
</tr>
<tr>
<td>Administering First Aid</td>
<td>34</td>
</tr>
</tbody>
</table>

All of the teachers reporting indicated that the process of splicing and soldering of wires was taught. Actually, the
data shown in Table 6 indicate that the eleven processes listed are taught in practically all of the schools.

Table 7 shows the replies of the industrial arts teachers concerning the broad topics of related information that they usually teach in connection with the processes included and taught in electricity.

**TABLE 7**

DATA CONCERNING THE RELATED INFORMATION MOST COMMONLY INCLUDED IN THE UNITS OF LEARNING DESIGNED FOR TEACHING ELECTRICITY AS A PHASE OF INDUSTRIAL ARTS IN FORTY-TWO SCHOOLS

<table>
<thead>
<tr>
<th>Related Information</th>
<th>Number of Schools in Which the Related Information Is Taught</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of Electricity</td>
<td>31</td>
</tr>
<tr>
<td>Safety Procedures</td>
<td>39</td>
</tr>
<tr>
<td>Job Opportunities</td>
<td>36</td>
</tr>
<tr>
<td>Terminology</td>
<td>36</td>
</tr>
<tr>
<td>Kinds, Sources, and Distribution of Electricity</td>
<td>37</td>
</tr>
<tr>
<td>Applications and Uses of Electricity</td>
<td>36</td>
</tr>
<tr>
<td>Types and Specifications for Wiring</td>
<td>29</td>
</tr>
<tr>
<td>Ohm's Law</td>
<td>29</td>
</tr>
<tr>
<td>Radio</td>
<td>29</td>
</tr>
<tr>
<td>Theory of Transformers and Condensers</td>
<td>34</td>
</tr>
<tr>
<td>Social and Economic Influence of Electricity</td>
<td>28</td>
</tr>
</tbody>
</table>
The data presented in Tables 6 and 7 indicate that the industrial arts teachers include in the units of learning the usual processes and related information pertaining to electricity listed in practically all of the bulletins and study guides published by the various state departments of education.

Preparation of Industrial Arts Teachers in Electricity

On the questionnaires, industrial arts was checked as the major teaching field of 165 of the 170 teachers who participated in the study. The number of semester hours of college preparation in electricity completed by the 170 teachers is shown in Table 8.

<table>
<thead>
<tr>
<th>Number of Semester Hours Completed in Electricity by Each Teacher</th>
<th>Number of Teachers</th>
<th>Percentage of Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>72</td>
<td>42</td>
</tr>
<tr>
<td>3</td>
<td>55</td>
<td>32</td>
</tr>
<tr>
<td>6</td>
<td>32</td>
<td>19</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>15 or more</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
When the number of semester hours of college preparation in the area of electricity is compared with the number of semester hours of work usually recommended by teacher education institutions for the areas of woodwork, metal, and drawing, these industrial arts teachers appear to be inadequately prepared in the area of electricity.

According to the data shown in Table 3, seventy-two, or 42 per cent, of the teachers who returned a questionnaire have no college preparation in the area of electricity, and fifty-five, or 32 per cent, of the group of industrial arts teachers have only three semester hours of college credit in the area of electricity. Only eleven, or less than 10 per cent, of the 170 teachers have completed nine or more semester hours of college preparation. It was found that a course in electricity was available to industrial arts teachers in the teacher education institutions attended by 67 per cent of the teachers who completed the questionnaire in this study.

The questionnaire also included a request for the opinions of the industrial arts teachers as to whether or not they believed that teacher education institutions should require students majoring in industrial arts to take one or more courses in electricity, and if so, how many semester hours should be required. The response to this question indicated that 154, or 90.8 per cent, of the 170 teachers who returned a questionnaire believed that electricity should be included as one of the major requirements by all teacher
education institutions offering industrial arts and preparing industrial arts teachers. The minimum number of semester hours in electricity considered necessary by these 170 teachers varied as follows: three semester hours of electricity were considered sufficient as a minimum requirement by fifty, or 31 per cent, of the teachers who reported; seventy, or 41.11 per cent, of the teachers were of the opinion that six semester hours of electricity should be required as a minimum for all prospective industrial arts teachers; sixteen, or 9.41 per cent, of these teachers believed that nine semester hours should be required; and eleven, or 6.47 per cent, of the teachers considered that twelve or more semester hours in the area of electricity should be required. College preparation in the area of electricity was considered unnecessary by twenty-two of the 170 industrial arts teachers who participated in the study.

Other Phases of Industrial Arts Taught in 128 Secondary Schools in Which No Electricity Is Taught

Data were obtained in order to determine the phases of industrial arts taught in schools where electricity is not offered. The results are included in Table 9. Attention was given to the various phases of industrial arts taught in the secondary schools of Texas. When the questionnaires that were returned from the 170 schools were examined, it was found that woodwork ranked first among the phases of industrial arts
taught in the schools where no electricity is offered, as shown by the data in Table 9.

TABLE 9

<table>
<thead>
<tr>
<th>Phases of Industrial Arts Offered</th>
<th>Number of Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crafts</td>
<td>79</td>
</tr>
<tr>
<td>Woodwork</td>
<td>125</td>
</tr>
<tr>
<td>Drawing</td>
<td>118</td>
</tr>
<tr>
<td>Metal Work</td>
<td>77</td>
</tr>
<tr>
<td>Auto Mechanics</td>
<td>12</td>
</tr>
<tr>
<td>Graphic Arts</td>
<td>6</td>
</tr>
<tr>
<td>Others</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 9 also reveals that drawing is offered in 118, or 92 per cent, of these schools. Courses in the area of crafts and metal work are offered in almost two-thirds of the schools, and courses in auto mechanics and graphic arts are included in less than 10 per cent of the industrial arts programs in the 117 schools in which no electricity is taught.

Another question believed to be pertinent to the study was stated in the questionnaire as follows: "In your opinion, do you believe electricity should be included and taught as a phase of industrial arts in the school where you are employed?" Replies to this question showed that 109, or 83 per cent, of
the industrial arts teachers employed in the schools of
group "B" were of the opinion that electricity should be in-
cluded in the curricula of the schools in which they were
employed and should be taught as a phase of industrial arts.

In order to determine whether or not teachers had reason
to believe that lay citizens in the local school community
would approve of the teaching of electricity as a phase of
industrial arts, a question concerning this phase was in-
cluded in the questionnaire. When the returned questionnaires
were examined, it was found that in 115 of the 128 schools
included in group "B," the teachers were of the opinion that
members of the local boards of education, the superintendent,
the principal, the parents, and the pupils would approve of
a course in electricity as an addition to the industrial arts
curriculum.

Miscellaneous Comments and Reasons Given As to
Why Electricity Was Not Taught As a Phase
of Industrial Arts in 128 Schools

When the returned questionnaires were examined, it was
found that sixty-nine of the 128 industrial arts teachers
employed in schools in which electricity was not taught as a
phase of industrial arts had completed three or more semester
hours in this area as part of their college preparation. Yet
many of the industrial arts teachers made comments on the
questionnaires indicating that electricity was not taught as
a phase of industrial arts because they did not believe they
were qualified to direct learning experiences in electricity on an elementary exploratory basis. Thirteen of the forty-two industrial arts teachers who teach electricity as a phase of industrial arts, however, reported that they did not receive any preparation in this area in their college preparation program.

In 102 of the 170 schools included in the study, the lack of space, lack of finances and equipment, and the lack of teachers who believed themselves qualified to teach electricity were listed as the major reasons why electricity was not taught. One of the teachers stated that electricity was not included in the industrial arts curriculum because the curriculum was too large; another commented that there were more requests for the different phases taught than he could teach without including electricity. One teacher commented that electricity was not taught because the lack of interest in industrial arts in the past had caused an out-of-date program. Other comments received as to why electricity was not offered in industrial arts programs included the following: "Instructors not qualified," "Additional teachers are needed in our industrial arts department," "We have recently added an area in metal; perhaps electricity will come later," and "No felt demand."
ANALYSIS OF THE DATA

In Chapter II the major recommendations concerning the teaching of electricity as set forth in bulletins and study guides for industrial arts, developed and published by sixteen state departments of education, were presented. The recommendations of others who have written articles and books pertaining to the subject of electricity as a phase of industrial arts were presented along with the results of some recent research studies seeking answers and information pertinent to some of the aspects of electricity that are often questioned. The data received through the use of the questionnaire concerning current practices in the teaching of electricity as a phase of industrial arts in the secondary schools of Texas were presented in Chapter III. In this chapter an attempt will be made to analyze the data presented in Chapter III in light of the recommendations presented in Chapter II.

Recommendations of Sixteen State Departments of Education

In thirteen of the sixteen bulletins received and examined, it was found that the state boards of education specifically recommend that electricity be taught as a phase of
industrial arts at the junior high school level. The states included in this group are California, Florida, Illinois, Indiana, Louisiana, Minnesota, Mississippi, Ohio, Oklahoma, Oregon, Utah, Texas, and the District of Columbia. In bulletins received from state departments of education in Iowa, Maine, and North Dakota, it was recommended that electricity be offered as a phase of industrial arts at the secondary level of general education, whereas the State Department of Education in Missouri stated in its bulletin that electricity should probably be placed in the tenth or eleventh grade, although local conditions might suggest a different grade level.\(^1\)

In addition to these suggestions it was also recommended that industrial arts students should be offered courses in electricity at more advanced levels, including the tenth, eleventh, and twelfth grades, and that these courses should be considered as recommended electives with emphasis being placed upon opportunities for experimentation on those phases of greatest interest to the student.

Similar recommendations were offered by the state departments of education in California, Florida, Illinois, Louisiana, Ohio, Oregon, Utah, Texas, and the District of Columbia. A statement illustrating current thinking pertinent to teaching electricity at a particular grade level was mentioned in a tentative bulletin, Planning, Organizing, and

\(^1\)Missouri State Department of Education, op. cit., p. 8.
Teaching Industrial Arts, being prepared by the Texas Education Agency, as follows:

For Level III, grades ten to twelve, objectives suggested for planning and developing units of learning in electricity will be the same as recommended in Level II, grades seven, eight, and nine, regardless of the size of the school system. The units of learning in electricity will continue to be exploratory but more advanced in nature than at Level II.2

Electricity As a Phase of Industrial Arts

Electricity is included as a phase of industrial arts at the junior high school level, including one or more of grades seven, eight, and nine, in thirty-five, or 85 per cent, of the schools which were reported; in sixteen, or 38 per cent, of the high schools, electricity is offered in one or more of grades ten, eleven, and twelve. The industrial arts teachers who reported for the forty-two schools in which electricity is taught indicated that a course in electricity has been a part of the industrial arts curriculum in twenty-nine, or 69 per cent, of the schools where they were employed for a period of time ranging from one year to five years.

Electricity is offered and taught as a regular unit course for one semester in ten, or 24 per cent, of the schools of group "A," according to the data received, and in twenty-eight, or 66.6 per cent, of these schools it is taught.

2Texas Education Agency, op. cit., Section III, p. 31.
for periods of time ranging from four to nine weeks. The unit plan for teaching electricity was reported as being used in ten, or 24 per cent, of the schools included in group "A," whereas in twenty-eight, or 66.6 per cent, of the schools it was indicated that the general industrial arts shop plan is used.

Electricity As Correlated with Other Areas of Industrial Arts

In the forty-two schools which offer electricity in a general industrial arts program, the areas with which it was reported as being correlated most often are woodwork, metal work, crafts, and drawing, as indicated in Table 1. In bulletins received from the state departments of education in Maine, Mississippi, Louisiana, Indiana, Texas, Florida, Oregon, and the District of Columbia, it was recommended that electricity be taught in correlation with other areas of work in the general industrial arts program, such as woodwork, metal, crafts, drawing, and others. The number of students enrolled in a regular class in electricity, according to information revealed in questionnaires returned from teachers in schools of group "A," was found to range from six to thirty students.

Textbooks Used in Electricity Classes

A particular textbook is used in seventeen, or 40.4 per cent, of electricity classes taught in the forty-two schools.
included in group "A." When the returned questionnaires were examined, it was found that of those schools in which a particular textbook in electricity was used, thirty-one, or 73.8 per cent, of the schools were using *General Shop Electricity* by Dragoo and Porter. The Industrial Education Association of Indiana recommended that in following its suggested outline, electricity classes should use as a text a book entitled *Fundamental Jobs in Electricity* by Perry and Schafbrook.\(^3\) It was noted, however, in the various state bulletins examined that the lists of reference books on electricity were very similar. Briggs, in a study entitled "The Development of Teaching Aids for Electricity," pointed out that often the material which is taught in electricity has become outmoded, since the students live in a very changing and dynamic world.\(^4\) Recent books in electricity reflect this change when they are compared with books that have been written in the past.

Briggs examined twelve different books recommended as texts in electricity and came to the conclusion that the books which most nearly fulfilled the requirements for a class in elementary electricity were *Industrial Arts Electricity* by Lush and Engle, *Basic Electricity* by Feirer and Williams, and *Fundamentals of Applied Electricity* by Jones. Briggs stated

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\(^3\)Indiana Education Association, *op. cit.*, p. 13.

that these three books were in agreement with respect to each of the various phases of electricity, but that no single book was found which would present as complete and flawless a coverage of material as would a combination of the three books mentioned.5

Another recent constructive criticism of the available books suitable for use in teaching electricity was disclosed by Crow in his book entitled Experimental Electricity for Beginners. This book concerns materials designed for present-day use in teaching electricity, with experiments arranged in what Crow believes to be the proper sequence.6 He expressed the following opinion in the introduction:

Every educator in the field of electricity is aware of the great need today for a good book on elementary electricity experiments. While it is true that there are some books in which certain electrical experiments are shown, it is equally true that none of them treat the subject adequately. . . . Experiments must follow a proper sequence; they must be related. Each experiment should logically evolve from the one preceding it; should be the outgrowth, modification of, or supplement to it.7

Thus it appears that no single book on the market today is entirely ample for use as a textbook in teaching electricity. Perhaps as a result of the growing demands in this field, additional material will soon become available, and future

5Ibid.

6Leonard R. Crow, Experimental Electricity for Beginners, p. iii.

7Ibid.
industrial arts classes will be provided with more suitable textbooks in electricity.

Instructional Aids Used in Teaching Electricity

Instructional aids, such as exploded drawings, test equipment, mock-ups, models, charts, posters, panels, and other aids are used in thirty-eight of the forty-two schools in which electricity is taught as a phase of industrial arts, according to the data presented in Table 2. In the Indiana bulletin the State Department of Education recommends that teaching aids be available and used in teaching a course in electricity;8 likewise, in the Utah bulletin the State Department of Education recommends that instructional aids and devices be used in teaching electricity.9 Briggs developed teaching aids which could be built in the local industrial arts shop and recommended their use in teaching electricity in industrial arts classes. In an article entitled "Teaching Electricity," Pawelek said that one of the most valuable aids for use in teaching electricity is the demonstration panel. A fundamental knowledge of practical electricity may be taught by the wise use of similar teaching aids.10 Data also revealed that in thirty-four, or 80 per cent, of the schools, plans are being made to acquire additional instructional aids and equipment for teaching electricity.

10Pawelek, op. cit., p. 257.
The data revealed that students in electricity classes were allowed to work with alternating current ranging up to 110 volts in thirty-seven of the forty-two schools included in group "A," and with direct current ranging up to twenty-four volts in thirty-eight of the schools. In a recent issue of School Shop it was recommended that students in electricity classes should be allowed to experiment with alternating current voltages ranging from two to seventy-five volts at each work station and that available circuit outlets in the shop should include both 110 volts and 220 volts of alternating current. From two to twenty-four volts of direct current were considered satisfactory for use at each work station. In courses offering such phases of electricity as advanced radio and electronics, direct current up to 500 volts and alternating current up to 220 volts were suggested.\textsuperscript{11}

Projects Developed by Students in Electricity Classes

A certain number of projects were required of students enrolled in electricity classes in eighteen of the schools; in twenty-four of the schools in which electricity is taught, the students were encouraged to develop projects in electricity that involve work in other areas of industrial arts.

Recommendations by various state departments of education were to the effect that electricity projects should include work in the areas of wood and metal.

Types of Tests Used in Teaching Electricity

The types of tests used by the teachers of electricity in those schools in group "A" were found to include such types of tests as the completion test, the true-false test, and the multiple-choice test. Some samples of these particular types of tests were shown and recommended in the bulletin published by the State Board of Education in Missouri. In other bulletins it was implied that objective types of tests were recommended for use in teaching industrial arts.

Most of the equipment available and used in teaching electricity was made in the local industrial arts shops of twenty-five, or 60 per cent, of the schools in which electricity is taught, whereas in seventeen, or 40 per cent, of the schools the data revealed that most of the equipment was purchased ready-built.

Floor Space Available for Electricity Classes

According to the data presented in the questionnaires, there was a wide variation in the amount of available floor space for classes in electricity, since the amount ranged from 100 square feet to more than 1500 square feet. Twenty

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of these teachers stated that additional floor space was needed for their classes in electricity; twenty-two of the teachers indicated that the amount of floor space available for their electricity classes was sufficient. Most authorities in the field of schoolhousing recommend that floor space for industrial arts programs be not less than fifty square feet per pupil; others have suggested up to 125 square feet per pupil. In a publication entitled *Planning School Buildings*, Donovan stated that the amount of space needed for each industrial arts shop can be determined in general by allowing from fifty to seventy-five square feet per pupil, depending upon the character of the program.\(^\text{13}\) In an article entitled "Planning the School Workshop from an Architect's Viewpoint," Ittner suggested that fifty square feet should be considered as the minimum but never the ideal size, and for classes of less than twenty pupils the minimum space should be no less than seventy to ninety square feet per pupil.\(^\text{14}\) Wenger stated in a recent article entitled "Check List for Planning and Evaluating School Shops" that industrial arts shops should vary from seventy-five square feet per student to a possible maximum of 125 square feet, depending upon (a) course offered, (b) grade level, (c) size


of class, and (d) extent of concentration desired.\textsuperscript{15} When the amount of floor space available for teaching electricity and the number of students per class were compared with the foregoing recommendations, it was found that the majority of the schools did not have a sufficient amount of floor space. Ten of the industrial arts teachers reported, however, that their schools were planning to provide additional space for use in teaching electricity.

Opinions As to Subject Matter Placement

It was the opinion of 126, or 74 per cent, of all of the teachers reporting that laboratory experiences in electricity should be taught as a phase of industrial arts, rather than in a science class, whereas twenty-seven, or 16 per cent, of the teachers were of the opinion that electricity should be taught in both science and industrial arts areas. The bulletins from the various state departments of education emphasize that electricity should be offered to industrial arts students in order that they may learn more about electricity from the practical standpoint rather than in a science class which appears to involve a great deal of theory. The bulletin published by the Missouri State Department of Education stated that the present problem is the education of people in the principles and practical applications of electricity.\textsuperscript{16}

\textsuperscript{15}Wanger, op. cit., p. 67.

\textsuperscript{16}Missouri State Department of Education, op. cit., p. 7.
In the industrial arts handbook published by the Utah State Department of Industrial Education, it was stated that electricity should be taught with special reference to its use in the home. Likewise, in the State of North Dakota, electricity is taught at the secondary level for the purpose of acquainting the student with its fundamentals and of instilling in him an appreciation of its importance and application in everyday living.

The California Committee on Industrial Arts Education stresses an appreciation for and an understanding of the part electricity plays in everyday living, the development of skill in the use of tools for simple electrical construction, safe work habits, and the ability to make elementary electrical repairs around the home, based on the exploratory level. The Florida State Board of Education places the study of electricity in a particular segment of industry designated as "power"; this course is taught as an exploratory unit. It is the recommendation of the State Department of Public Instruction in Iowa that the boys and girls of today should have an opportunity to learn about electricity and its safe use as a part of their general education.

17 Utah State Department of Industrial Education, op. cit., p. 63.
19 California State Department of Education, op. cit., p. 20.
in order to provide them with an understanding of modern industry and to secure information that will aid them in the selection, care, and use of its many products.\textsuperscript{21} When the extent to which electricity is taught as a phase of industrial arts in the 170 schools included in this study is compared with the aforementioned recommendation, it is very obvious that the industrial arts curricula in these schools are not adequate.

Correlation of Electricity with Other Phases of Industrial Arts

Electricity is being correlated with other subject matter areas, such as English, mathematics, social science, and others, according to data submitted by twenty-seven teachers. Mention was made earlier in the study that several state departments of education have no state-organized and state-administered industrial arts programs; in such cases the selection and organization of the learning experiences in industrial arts are left up to the individual school system. An example of this situation exists in the state of Colorado. The Denver Public Schools have recently published an excellent bulletin, however, entitled \textit{Industrial Arts in the Denver Public Schools} in which several pages are devoted to the correlation of industrial arts with other subject matter areas.

\textsuperscript{21}Iowa State Department of Public Instruction, \textit{op. cit.}, p. 92.
such as English, mathematics, social science, and others.\(^{22}\)

In a recent article published in *School Shop*, Wilber added emphasis to the idea of correlating industrial arts with other subject matter areas when he discussed some of the basic concepts of correlating industrial arts with other subject matter areas as follows:

> Teachers, supervisors, and school administrators should begin to redefine their aims and objectives, not in terms of projects—but rather in terms of specific behavior patterns toward which it is desired that students grow, and further, the programs should be primarily directed toward the achievement of these ends. It does not appear to be of primary importance that each pupil learn how to make a mortise-and-tenon joint or to make a perfect Western Union splice, but it is important that pupils learn to work cooperatively together. Industrial arts should teach pupils to think and plan, and it appears that these must be taught the same as any other skill and the wise teacher will be as much concerned with teaching his pupils to think and plan as he is in teaching them to construct. . . . What is needed is teachers who are not afraid to experiment. . . . One must first determine the type of behavior in which he is interested and then devise some instrument, technique, or method so that growth toward these ends can be observed.\(^{23}\)

If these recommendations are accepted, it is evident that in the teaching of electricity or any other area of industrial arts the various areas should be correlated with other subject matter whenever possible, if the industrial arts learning experiences are to provide a broad and rich program. The data

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indicate that in approximately one-third of the schools in which electricity is currently taught, attention should be given to greater correlation of the learning experiences in electricity in industrial arts with the other subject matter areas.

Processes, Technical and Related Information

The teachers of electricity in practically all of the forty-two schools in group "A" indicated that they included about the same processes and related information in the units of learning usually included in the various state bulletins. An example of the processes and other related information usually recommended for units of learning in electricity may be seen in the tentative bulletin which is in preparation by the Texas Education Agency. Most of the bulletins examined in this study contain a list of processes and related information to be included in the program for the purpose of providing opportunities of an exploratory nature in the area of electricity.

The other phases of industrial arts offered in the 128 schools in which no electricity is offered, according to data received, include crafts, woodwork, metal work, auto mechanics, and graphic arts. Woodwork and metal work appear to be the most common phases offered. The data also revealed that in each school in which electricity is not taught in the industrial arts program, there are from one to nine industrial arts teachers employed.
No doubt continued research would reveal additional information related to electricity as taught as a phase of industrial arts in the secondary schools of Texas, such as types of instructional aids and equipment available, types of projects usually used in teaching electricity, and opinions of the industrial arts teachers as to the processes and technical and related information they believe should be taught. No doubt industrial arts teachers could give recommendations that would be of value to teacher education institutions concerning the nature of courses designed to prepare industrial arts teachers in the area of electricity.
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to analyze the current practices in the teaching of electricity as a phase of industrial arts in the secondary schools of Texas. In addition to the purpose of the study, certain terms used in the study, the procedure of the study, source of data, and some of the results of recent and related studies pertinent to this study were presented in Chapter I.

Chapter II of the study contains a treatment of the growth and uses of electricity in the United States during the last century. The literature in the field of electricity and secondary education which emphasized curriculum construction and learning experiences for secondary school youth was reviewed to ascertain whether or not those individuals who had written extensively believed that a knowledge of electricity was desirable and whether or not they believed electricity should be included in the curriculum of the secondary school. The opinions and recommendations of these individuals were also presented and discussed. Each of the state departments of education in the forty-eight states was contacted to find out whether or not bulletins and/or study
guides for industrial arts had been prepared and published for use by industrial arts teachers. It was found that only sixteen of the forty-eight states had prepared and made available bulletins containing information and recommendations concerning electricity for use by industrial arts teachers. The bulletins received from these sixteen state departments of education were examined to determine to what extent electricity was considered as a phase of industrial arts and what recommendations and suggestions each of the bulletins contained concerning the teaching of electricity. These recommendations and suggestions were also presented in Chapter II. In order to obtain data and information with respect to the current practices as related to electricity taught as a phase of industrial arts in the secondary schools of Texas, a questionnaire was designed and used. A copy of the questionnaire was mailed to 350 teachers of industrial arts. Of the 350 questionnaires mailed, 170 were completed and returned, all of which were usable. When the questionnaires were examined, it was found that electricity was taught in only forty-two of the 170 schools reported. The data and information concerning the processes and technical and related information usually taught in electricity, the amount of instructional aids and equipment available in the schools for teaching electricity, reasons why electricity was not taught, the preparation of the teachers in the area of
electricity, and miscellaneous other data received through the use of the questionnaire were presented in Chapter III.

In Chapter IV an analysis of the data was made. In order to analyze the data, it was necessary to restate in many instances the recommendations and suggestions contained in the sixteen bulletins examined and used in the study and to compare or analyze the data presented in Chapter III in light of the recommendations.

In addition to the above summary, in Chapter V the findings of the study and some of the recommendations which emerged as a result of the study will be presented. No doubt further research and analysis of the data would reveal more information concerning the current practices as related to the teaching of electricity as a phase of industrial arts in the secondary schools of Texas.

Conclusions

When the data and information secured for the study were studied and analyzed, the following facts pertinent to electricity taught as a phase of industrial arts in the secondary schools of Texas were found:

1. Based upon the recommendations contained in sixteen bulletins published by sixteen of the forty-eight state departments of education, electricity should be included and taught as a phase of industrial arts both to boys and girls enrolled in secondary education.
2. Efforts should be made by each of the forty-eight state departments of education which has not prepared and published a bulletin or study guide for industrial arts to prepare such material for use by industrial arts teachers as a means of improving instruction in this area for pupils enrolled in schools at the secondary level.

3. An analysis of the bulletins examined and of the recent and related research studies pertaining to electricity as a phase of industrial arts indicates that there is much similarity in the recommendations and suggestions as to the types of learning experiences, processes, and other related and technical information to be taught concerning electricity.

4. Electricity is taught as a phase of industrial arts in only forty-two, or 24.7 per cent, of the 170 schools included in this study. One or more phases of industrial arts is taught in these schools, even though the teaching of electricity as a phase of industrial arts has been recommended for several years by the Texas Education Agency.

5. According to the data secured and presented in this study, the teachers in the forty-two schools in which electricity is taught as a phase of industrial arts reported that they were teaching practically the same processes and technical and related information concerning electricity as those recommended in the bulletin for industrial arts published by the Texas Education Agency.
6. In the majority of the schools in which electricity is taught, according to the data received, the instructional aids and equipment for teaching electricity as a phase of industrial arts are adequate.

7. One of the major reasons given as to why electricity is not taught as a phase of industrial arts in 128 of the 170 schools was that there was not available floor space for this activity.

8. The second major reason given as to why electricity is not taught in 128 of the 170 schools was that the industrial arts teachers themselves expressed the belief that they were not prepared adequately to teach electricity. The data show that seventy-one of the teachers had no formal college preparation in the area of electricity and that fifty-four of the teachers had only three semester hours.

9. Approximately one half of the teachers in the forty-two schools in which electricity was reported as being taught require a specified number of projects to be constructed by students taking electricity.

10. The data indicated that the industrial arts teachers make little effort to correlate electricity with the other phases of industrial arts, such as woodwork, metal, crafts, and drawing.

11. The greater majority of the 170 industrial arts teachers were of the opinion that electricity should be
taught as a phase of industrial arts in the secondary schools of Texas and recommended that teacher education institutions require each student preparing to teach industrial arts to complete from three to nine semester hours of work in the area of electricity.

Recommendations

Based upon the results of this study the following recommendations are made:

1. That boys and girls be offered a course in electricity as a regular phase of industrial arts in the secondary schools.

2. That teacher education institutions consider the possibility of requiring more electricity as a part of the program designed to prepare industrial arts teachers.

3. That greater effort on the part of industrial arts teachers be made to correlate electricity and its uses with the other phases of industrial arts, such as woodwork, metal, crafts, and drawing.

4. That school administrators and others responsible for the secondary school curriculum be made more aware of the need for including electricity in the learning experiences of boys and girls.
October 2, 1953

Superintendent of Schools

Dear Sir:

To expedite a graduate project being developed at North Texas State College, Denton, Texas, I would like to have the names and addresses of the Industrial Arts teachers in your school system. A self-addressed postcard is enclosed.

Please accept my thanks for this courtesy.

Sincerely yours,

L. Lyle Baker
Graduate Assistant
I am making a study for the purpose of identifying and analyzing some of the current practices in electricity in industrial arts programs as a means of improving this phase of teacher education. An effort has been made to construct an inquiry so that it will require a minimum of your time to supply the data. Your cooperation in this study will be greatly appreciated.

I wish to assure you that names of individuals and institutions will be kept strictly confidential. Supplementary comments and statements you wish to make concerning your teaching program will be appreciated.

Yours very sincerely,

L. LYLE BAKER
Graduate Assistant
North Texas State College

1. Is electricity taught in the Industrial Arts department of your school?

   Yes____, No____. If electricity is not taught in your school, please omit questions 2 through 21 of this questionnaire.

2. If electricity is included as a phase of industrial arts, at what grade level is it offered? __________.  

3. Approximately how many years has electricity been offered in the local school? __________.

4. If electricity is offered, is it taught for one semester as a regular unit course? Yes____, No____. If not taught for a semester, how many weeks is it offered? ______.

5. Please indicate the plan used for teaching electricity. Unit Plan______, or general shop plan_________.

AN ANALYSIS OF ELECTRICITY AS TAUGHT IN THE SECONDARY SCHOOLS OF TEXAS
6. If electricity is included in a general shop program, please indicate the other areas with which it is correlated, as follows: Woodwork_____,
   Metal_____, Crafts_____, Drawing_____, others_____.

7. What is the average number of students in a regular class in electricity?_____.

8. Is a particular textbook used? Yes_____, No_____. If so, give title_________________ and author_________________

9. Are teaching aids available for use in teaching electricity, such as exploded drawings, Yes_____, No_____, test equipment, Yes_____, No_____,
   mock-ups, Yes_____, No_____, models, Yes_____, No_____, charts, Yes_____,
   No_____, posters, Yes_____, No_____, panels, Yes_____, No_____, others_____.

10. What is the highest voltage students are allowed to work with when using A. C. current?_____, when using D. C. current?_____.

11. Is a certain number of projects required by each student? Yes_____, No_____.

12. Are students encouraged to develop projects in electricity that involve work in other areas of industrial arts? Yes_____, No_____.

13. Please indicate the type of tests used: completion_____, true-false_____,
   multiple-choice_____, others_____.

14. Was most of the equipment for teaching electricity made in the local school shop? Yes_____, No_____, or purchased ready-built? Yes_____, No_____.

15. Approximately how many square feet of floor space are used in the local school shop by a class in electricity?_____. Does this space appear to be adequate? Yes_____, No_____.

16. Does the school plan to provide additional space for teaching electricity? Yes_____, No_____.

17. Are there any plans to acquire additional aids and equipment for teaching electricity? Yes_____, No_____.
18. In your opinion, do you think laboratory experiences in electricity should be taught in a science class, rather than as a phase of industrial arts? Yes____, No____.

19. In teaching electricity, do you try to correlate with it other subject matter areas, such as English, mathematics, and social studies? Yes____, No____. If so, please indicate the areas included__________________________

20. Please check the following processes and related information usually used in teaching electricity:

<table>
<thead>
<tr>
<th>PROCESSES</th>
<th>RELATED INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making and reading wiring diagrams.</td>
<td>History of electricity.</td>
</tr>
<tr>
<td>Splicing and soldering</td>
<td>Safety procedures</td>
</tr>
<tr>
<td>Use of circuits</td>
<td>Job opportunities</td>
</tr>
<tr>
<td>Use of conductors and insulators</td>
<td>Terminology</td>
</tr>
<tr>
<td>Use of fuses and multi-breakers</td>
<td>Kinds, sources and distribution of electricity</td>
</tr>
<tr>
<td>Use of resistances</td>
<td>Applications and uses of electricity</td>
</tr>
<tr>
<td>Use of testing equipment</td>
<td>Types and specifications of wiring</td>
</tr>
<tr>
<td>Installation processes</td>
<td>Ohm's law</td>
</tr>
<tr>
<td>Uses of electrical measuring</td>
<td>Radio</td>
</tr>
<tr>
<td>devices</td>
<td>Theory of transformers and condensers</td>
</tr>
<tr>
<td>Use and care of common household</td>
<td>Social and economic influence of electricity</td>
</tr>
<tr>
<td>appliances</td>
<td></td>
</tr>
<tr>
<td>Administering first aid</td>
<td></td>
</tr>
</tbody>
</table>

21. Are some students excluded from taking electricity, due to fear on the part of their parents? Yes____, No____.

22. Is Industrial Arts your major_____ or minor_____ teaching field?

23. How many college hours have you completed in the area of electricity_____.

24. Please indicate the phases of industrial arts offered in the local school.
25. How many industrial arts teachers are employed in the local school? ____.

26. In your opinion, do you believe electricity should be included in the field of industrial arts in the school where you are employed? Yes____, No____.

27. Do you have reason to believe that the following parties would approve electricity being taught as a phase of industrial arts in the local school? The Board of Education? Yes____, No____, the superintendent? Yes____, No____, the principal? Yes____, No____, the parents? Yes____, No____, the students? Yes____, No____.

28. Was a course in electricity offered to industrial arts students by the college which you attended? Yes____, No____. If not, do you believe this lack of preparation on the part of the college has tended to prevent your teaching electricity? Yes____, No____.

29. In your opinion, are there other reasons why electricity is not offered in the local school? ____________________________

30. Do you believe teacher education institutions should require students majoring in industrial arts to take electricity? Yes____, No____. If so, how many semester hours? ____.

31. When this study is completed, would you like to receive a summary of the findings? Yes____, No____.
BIBLIOGRAPHY

Books


Fun with Dry Batteries, New York, National Carbon Company.


Bulletins


Denver Public Schools, Industrial Arts in the Denver Public Schools, Denver, 1952.


**Articles**


Newspapers

Daily Times Herald, Dallas, Texas, July 26, 1953, Section Six, pp. 15-17.

Kane, Margaret, "Housewife Needn't Be in Dark About Electric Wiring Gadgets," Daily Times Herald, Dallas, Texas, November 2, 1953, Section Three, p. 1.

Unpublished Material


Weaver, R. J., "Electricity for the Junior High School General Shop," Unpublished Master's thesis, Department of Industrial Arts, University of Indiana, 1941.