INDUSTRIAL ARTS

FOR SECONDARY SCHOOLS

STATE OF IOWA, 1948

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INDUSTRIAL ARTS
FOR SECONDARY SCHOOLS

IOWA SECONDARY SCHOOL
COOPERATIVE CURRICULUM
PROGRAM
VOLUME III

ISSUED BY THE
DEPARTMENT OF
PUBLIC INSTRUCTION
JESSIE M. PARKER
SUPERINTENDENT
DES MOINES, IOWA

PUBLISHED BY THE STATE OF IOWA, 1948

IOWA SECONDARY SCHOOL COOPERATIVE CURRICULUM PROGRAM

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FOREWORD

The Industrial Arts Handbook is one of a series of publications produced in connection with the Iowa Secondary School Cooperative Curriculum Program. It is designed to present "some of the currently approved practices in industrial arts teaching, supplemented with selected lists of books, equipment, and other material."

That Iowa high schools in many instances need the type of assistance offered by this handbook goes without question. The scope of the usual industrial arts program needs to be broadened. School shops need to be enlarged and improved to permit of a broader program, and teaching techniques and equipment are in need of improvement. This handbook offers administrators and instructors worthwhile material for such program improvement.

Grateful acknowledgment is made to the members of the committee which prepared the handbook: W. H. Wagner, Assistant Professor of Industrial Arts at Iowa State Teachers College, Chairman; Joe E. Cuffel of Cherokee, Robert L. Coon of Forest City, Lewis A. Jones of Spencer, and Eldon W. Danne, Professor of Industrial Arts at Western Union College. The Department of Public Instruction is particularly grateful to Mr. W. H. Wagner, the committee chairman, whose leadership and industry made the early publication of the handbook possible. Thanks are also extended to other members of the industrial arts staff at Iowa State Teachers College for their encouragement and assistance.

JESSIE M. PARKER
Superintendent of Public Instruction

April, 1948

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1. CURRENT STATUS OF INDUSTRIAL ARTS IN IOWA

During the period from 1934 to 1944 the total number of high schools offering an industrial arts program decreased from 70 to 63 per cent. Large high schools showed some increase which indicates that industrial arts offerings have been discontinued in many of our smaller schools. There have been some very definite reasons for this decline. Most important has been the lack of well qualified teachers in the field. During the war years industrial arts teachers were in demand not only by the armed forces but also by industry. They possessed many skills which resulted in their becoming key men in the industrial effort. This shortage of teachers continues in the post-war years, because many former industrial arts teachers have not returned to the profession.

Another important factor has been the difficulty in securing equipment, materials, and supplies for industrial arts departments. The need for an adequate physical set-up in industrial arts is probably greater than in any other area of the curriculum. Due to the great demand by war industries, little was left in the way of machines and tools that could be secured for teaching in situations in the public schools. Many materials which were used in industrial arts activities either had to be substituted for or subtracted from the program.

The effect of these problems was most evident in the smaller schools. Larger high schools and city schools were often able to secure and more completely justify deferments for their teachers. They did not feel the material shortage as severely because of a large pre-war stock. Many city schools were able to make advantageous contacts with near-by manufacturing firms, who furnished them with usable scrap. Some of the smaller high schools were forced to close their shops entirely or continue with teachers who did not have an adequate background to handle the work. Where shops were discontinued, the rooms were converted into storerooms or taken over for maintenance of the school building. In some cases the equipment was badly misused or lost. In situations where the courses were continued, the areas of work were usually

reduced and in most of our smaller high schools today we find only offerings in woodworking, sometimes supplemented with mechanical drawing. It is difficult to justify this limited offering in these modern times.

In many of these woodworking shops plans are "ready-made" by the instructor, leaving little chance for planning by the student. This limits to a great extent the desirable outcomes which are a part of a suitable industrial arts program. In such situations emphasis is placed largely on skills. The project often becomes an end in itself rather than the means to an end. Many times the annual exhibit of woodwork projects held at the end of the year becomes one of the major objectives of the teacher, and the more important objectives of developing the student along the lines that will help him to fit into a highly specialized and industrial life are given second consideration.

Another problem which has retarded the development of desirable industrial arts programs (and once again this is especially true of the smaller high schools) is the tendency which has existed over a period of years of combining the teaching of physical education or coaching and industrial arts. These two areas necessarily require as much time as any other areas in the curriculum. Many communities have demanded a winning team to the extent that the industrial arts shop has been neglected. More desirable combinations in the future will result in industrial arts teachers being prepared to teach subjects in the field of science, mathematics, or social studies.

An industrial arts laboratory of the type which adequately fills the needs of the students, by giving them varied experiences in many types of material, requires an exceptional teacher and an extensive layout of tools, machines, and equipment.

On the other side of the balance, the future of industrial arts in Iowa looks promising. In general, school administrators are highly interested in developing a desirable program in industrial arts. Due to many lessons learned and made evident during the war effort, people are becoming more critical of the educational program and are demanding emphasis along the lines of the practical arts. This has been reflected in the attitude of boards of education to the extent that sufficient

funds can and will be appropriated for the expansion and development of a well-rounded program in industrial arts as well as in other areas. The great need, and the one which will not be immediately satisfied, is the staffing of industrial arts programs with teachers who have a progressive outlook and an adequate background of experience.

At the present time, common to all schools, is a lack of uniformity in the industrial arts curriculum offering. These inconsistencies are evident in such items as teacher qualifications, course content, grade placement, time allotments, and amount of credit. It is hoped that this publication will aid materially in adjusting some of these problems, for without uniformity in the above items, efficient administration is extremely difficult.

2. THE NEED FOR AN INDUSTRIAL ARTS PROGRAM

The need for an industrial arts program can be shown to a great extent by comparing conditions which existed several generations ago with those of today. During the nineteenth century, and prior to the time that the Industrial Revolution had affected the American economy, there was little need for a program of industrial arts in the schools. The boy and girl of those times had a first-hand opportunity to observe and study the existing social and economic plan. On the way to and from school they could observe the blacksmith, cooper, miller, tinsmith, cobbler, and many other village tradesmen at work. Not only were they able to observe the industrial life of the community, but they had many opportunities to participate in these activities. Much of the fabrication of consumer goods was centered around the home. Here the boy and girl had an opportunity to participate in the activities of spinning, weaving, soap making, food preparation, and many others. To supplement this environment the schools needed to offer little beyond the three R's. In general, the boys and girls were well equipped to fit into the social economic life when they became adults.

Let us compare this with the situation which exists today. Due to improved methods of transportation and manufacturing, industry became centralized in larger cities. Industrial activities in the home and village gradually disappeared. Boys and girls were no longer able to see and appreciate industrial

processes. Nearly all of the consumer goods which we are familiar with today in the areas of food, clothing, and shelter come to us ready-made. The boys and girls of today have no opportunity to observe, study, or participate in our industrial economy. Not only has this scene been removed from the casual observance of the students, but it has become highly complicated and specialized. During the last two generations, science and technology have advanced more than ever before in history. In the field of transportation alone, there have been such new developments as the diesel and electric locomotives, the perfection of the automobile, luxury ocean liners, and conventional and jet-powered aircraft.

The great problem of providing modern youth with an appreciation of today's industrial economy has been delegated in part to the industrial arts program of the public schools. Because of the rapid progress and changing conditions since 1880, when the first shop work was introduced into the American public schools, this program has necessarily seen many changes. A few hand skills, information and experience in a limited area do not meet the current needs of our modern society. Present leaders in the field of industrial arts education feel that a so-called "Laboratory of Industries," in which a student has opportunity to plan, study, investigate, and experiment through the use of construction problems in many areas, more completely fills the need of our present-day civilization.

Another problem which the industrial arts program can aid in solving, is that dealing with the worthy use of leisure time. With the changing social-economic picture has come a great amount of leisure time for boys and girls as well as adults. Several generations ago their time after school and during week-ends was pretty well accounted for. Today, however, especially in towns and cities, boys and girls find many hours during which they have no particular thing to do. The use of this time in the American scene is developing into a major problem.

3. USE AND PURPOSE OF THIS HANDBOOK

This handbook is a sincere effort on the part of the committee to present in practical form some of the currently approved practices in industrial arts teaching, supplemented with selected lists of books, equipment, and other material.

The last publication of this kind was sponsored by the Department of Public Instruction in 1930. A cooperative study of the industrial arts curriculum was made by teachers over the state in 1940 and resulted in a mimeographed handbook, often referred to as "The Blue Book." These manuals were valuable and filled a real need in the industrial arts program over the state.

Material of this type soon becomes outmoded and inadequate. The above-mentioned studies were too far apart. The committee strongly advises that as this handbook is distributed and implemented in the schools of Iowa, plans be made for the organization of a new and continuing curriculum study. It is our hope that this handbook may fill in part the current need for such material, and that it be studied, revised, and re-edited within a very short time.

According to figures for the 1945-46 school year, Iowa had a total of 872 high schools. Of this number 628 had enrollments of under 100 students. The material presented, therefore, is aimed most directly at helping the smaller schools. The basic principles, objectives, and methods will apply to any situation; however, as these are described more completely through examples and explanations, the small "one teacher" situation has been emphasized. Also the need is greater in the small high school, as larger schools usually have a staff of industrial arts teachers that are qualified to develop such material.

The committee would indeed be ungrateful if they did not express appreciation to the industrial arts teachers throughout the state who gave of their time and effort in promoting this project. Also thanks must go to publishers and manufacturing corporations who so willingly supplied materials for study.

This handbook has many limitations. Some sections are inadequate and some materials and areas are not included. However, the committee is sincere in its wish that it will serve in some small way to improve and promote the status of industrial arts in Iowa.

THE PRODUCTION COMMITTEE

Chapter I

ORIGIN AND PURPOSE

1. BRIEF HISTORY OF INDUSTRIAL ARTS IN THE PUBLIC SCHOOLS OF THE UNITED STATES

The first shop work was introduced into the public schools of the United States in 1880. It was called manual training and was a direct result of the Manual Labor movement and the exhibits of the Imperial Technical School of Moscow displayed at the Centennial Exposition in Philadelphia during the summer of 1876. Two leaders in promoting and establishing this program were Dr. C. M. Woodward and Dr. John D. Runkle.

The work consisted of a series of graded exercises in wood and metal through which the students progressed. The organization of manual training classes was very formal in nature. All students worked on an assigned exercise at the same time. The exercises consisted of such items as making a half-lap joint, chipping or filing a certain size notch or groove in a piece of metal. The program was justified largely on the development of skills, training for the hand and mind, as was made evident in the famous motto which was carved over the door of Woodward's school in St. Louis and read:

> Hail to the skillful, cunning hand!
> Hail to the cultured mind!
> Contending for the world's command,
> Here let them be combined.

For a number of years the work differed little from that copied from the Russian system. In the year 1886 Gustaf Larsson introduced into the schools of Boston a type of shop work which was known as Sloyd, a development of Sweden, his native land. This was a type of work long practiced by the Scandinavian countries and promoted to a large extent by Otto Salomon. The chief characteristic of Sloyd was that instead of a set of graded exercises, it was based on a group of useful articles, such as stools, utensils, boxes, and simple household items, carefully selected and arranged in regard to the skill involved in their fabrication. Manual training and

Sloyd developed side by side, each exerting considerable influence one on the other.

By 1900 changes in the basic philosophy of education began to affect manual training. The principles of faculty psychology could justify this type of work completely. However, the validity of this school of thought was being questioned. Through the leadership of John Dewey a new philosophy of education was developing which placed a new psychological emphasis on shop work. As a result there emerged a new program where consideration was given to the individual student who designed and constructed a project of his own selection. The formality of the old manual training gave way to the influence of Sloyd and changing education philosophy, to become a new shop program called Manual Arts. Some of the more notable leaders in the Manual Arts Movement were Bennett, Roberts, Griffith, Bawden, Snedden, Bonser, and Selvidge. Through their influence manual arts developed and predominated until about the time of the first World War.

Some years before the war still another concept was taking shape which was to lead to our present industrial arts program. It was the "Industrial-Social" theory, first defined by Dr. Frederick G. Bonser, Columbia University, in which he stated, "Industrial arts is the study of the changes made by man in the form of material to increase their values and of the problems of life related to these changes." Involved in such a definition are many implications. Emphasis is removed from the project and placed on educational ends. This new concept resulted in the creation of the general shop or laboratory in which many industrial activities were represented.

The older wood shop, metal shop, or drawing room could not meet these newly recognized needs. Further, the new program required a new type of teacher, one who was well prepared in educational methods and procedures in addition to previous requirements.

Since the first World War schools of America have made an attempt to adjust their shop program to this industrial-social theory. Due to the traditional pattern of our secondary education, it has been extremely difficult, and many schools have settled for far less than what is now considered as an adequate industrial arts program. Progress has been slow

because manual arts and manual training programs are so much easier to organize and administer, and because they require a teacher with less educational background and preparation.

The industrial arts teacher could profit by making further study of the history of industrial arts through the references listed at the end of this section.

2. PURPOSE AND POINT OF VIEW

One of the essential challenges of our modern schools is to offer an adequate and effective educational program to the children of a highly developed and ever changing industrial society. Our goal is to offer a program in industrial arts which will make a definite and important contribution to such a need.

Industrial arts and other practical arts is a basic area of work activities around which our civilization is built. The student of industrial arts comes face to face with real life problems in the shop and laboratory where practical application of knowledges gained in many other areas of the curriculum can also be made. Industrial arts is fundamentally important in general education as it enables every student to better understand our country and its important activities, materials, products, processes, tools, machines, services, etc. Provisions are also made for developing the various functional requirements of a technological democratic society.

All education should be geared to fit the needs of the students which it serves. If properly administered a good industrial arts program will contribute its full share to the total education of the child for modern and efficient living. Courses should be organized as integral parts of general education on a functional basis and flexible enough to meet individual needs and differences.

Students should be greatly encouraged to perform their work to the best of their ability. The activities, problems or projects should be developed preferably on a student-teacher participation basis in light of the student's needs and within his realm of interest and ability to execute.

Course materials and experiences for industrial arts programs should be derived preferably from the type of community and society in which we find ourselves. Industrial arts

educates through participation in various real life activities and situations instead of through abstractions and delayed application theories. The changing of many materials into usable products to meet specific needs of a dynamic social order offers effective training for interpretation, appreciation, and utilization of the countless modern conveniences and services of our fundamentally industrial society.

Innumerable production foremen of our industrial organizations proclaim that adaptability and cooperation of the individual are far more important than highly developed special skills. Millions of people are now compelled to change types of work several times during a life span, and the ability to adjust and fit into new situations successfully is of paramount importance for our own national well being.

New inventions, techniques, devices, and machines result in many new and different products and quite often fewer hours of work. Provision must be made for the intelligent consumption of these new goods as well as for the constructive use of the additional leisure time. Properly administered, the industrial arts program offers one of the means to the effective solutions of some of these social-economic problems.

A functional modern program of industrial arts would provide the following:

(1) Work experience in as many areas as possible.
(2) Use of representative occupational tools.
(3) Exploration of the handicrafts.
(4) Acquaintance with modern methods of production.
(5) Application of safety and sanitary factors peculiar to any type of work.
(6) Trace raw materials to finished products.
(7) How to select and use commercial goods and services.
(8) Effect of inventions on society and industry.
(9) Study of kinds, principles, and uses of power, transportation, communication, construction, and manufacturing.
(10) Survey of vocational opportunities.
(11) Develop personal recreation activities and elementary skills.
(12) Personal guidance.

3. OBJECTIVES FOR AN INDUSTRIAL ARTS PROGRAM

(1) To provide an opportunity for students to develop desirable interests, attitudes, habits, and character traits through participation in cooperative work.

(2) To provide an opportunity for students to develop an appreciation for good workmanship, design, and value of industrial materials and products.
(3) To provide an opportunity for students to learn to plan and construct things of value and beauty involving the use of the more common hand tools, machines, and materials.
(4) To provide an opportunity for students to acquire the necessary information for the intelligent selection, care, and use of the common products of industry.
(5) To provide an opportunity for students to gain an intelligent insight of a technological nature through which they may be able to consider and plan their direction for living and working in a democracy.
(6) To provide an opportunity for students to develop desirable recreational and avocational activities in the field of craftsmanship.
(7) To provide an opportunity for students to become familiar with and interested in maintenance and improvement in the home and farm.
(8) To provide an opportunity for students to develop a body of information and training, which will aid them in avoiding accidents to themselves and in preventing accidents to others.

It is important to develop a formal list of objectives for an industrial arts program. However, the real challenge to the teacher is the development of a plan through which these objectives may be attained.

Many industrial arts teachers have developed adequate plans for the teaching of specific information, skills, and techniques but have made little or no provision for developing appreciations, desirable attitudes, and habits. In general they feel that such development is attained through indirect or concomitant learning and is an outcome of their courses, regardless of any formal plan or special direction. In part, this is true. However, with the importance which is now being placed on attitudes, habits, and ideals in our modern educational program, their development must not be a matter of chance. The objectives listed will be fully attained only when there is as much attention given to the planning of the so-called indirect learning situation as is devoted to the development of information, skills, and techniques. It is of little value to make plans for the teaching of specific subject matter if no provision is made for experiences aimed at the development of appreciations, desirable attitudes, habits, and ideals.

4. SUGGESTIONS FOR ATTAINING THE OBJECTIVES

(1) TO PROVIDE AN OPPORTUNITY FOR STUDENTS TO DEVELOP DESIRABLE INTERESTS, ATTITUDES, HABITS, AND CHARACTER TRAITS THROUGH PARTICIPATION IN COOPERATIVE WORK.

A wholesome interest in people, their work, and the material things about them is an important part of the life of any boy or girl. The industrial arts laboratory provides an ideal situation in which to develop and promote this interest.

In general, individuals are interested in those things in which they have had experience. Therefore, it is the problem of the industrial arts teacher to provide activities in a number of areas of work. This should be supplemented with exhibits, field trips, films, and books as well as by discussion periods.

Numerous studies have verified that factual materials are easily forgotten, especially when they are not frequently used. However, attitudes, habits, and character traits, if properly acquired, are relatively permanent. Many more people fail in life because of a deficiency in these traits than because of a lack of the ability to do the work.

Other areas of the curriculum will also want to assume responsibility in this matter. However, industrial arts teachers must recognize that they hold a unique position and a definite responsibility in developing desirable attitudes, habits, and traits.

The term "character traits" may be broken down into more specific items for consideration as follows: honesty, neatness, courtesy, dependability, cooperativeness, etc. In the living, moving situation of the industrial arts laboratory, the student has an opportunity to be honest with himself and with others in the care and return of equipment, checking out and use of materials, tabulation of costs, and sharing of locker space with other students.

There is little opportunity to develop honesty in a shop where all materials are checked out by the instructor, tools and equipment are kept under lock and key, and students are so completely supervised that they have no freedom of action. How completely such controls can be lifted will depend upon the given situation. It should be kept in mind that there is little

chance for developing honesty in a situation if the individual has no chance to be dishonest.

Another example of the development of character traits can be built around neatness and orderliness. A standard in this respect can be established to a large extent through the "housekeeping" that exists in the industrial arts laboratory. Certainly a student will be inclined to give little thought to his own appearance and the things with which he is working if he is surrounded by dust, dirt, unkept shelves and equipment, discarded materials, soiled windows and walls, and other untidiness. Inexperienced workers will not be aware of the desirability of neatness and order. For example, the student may not realize that he has to do extra sanding on his white pine wall shelf because he has handled the work with soiled hands. It will be the responsibility of the instructor to point out these things as well as to see that a convenient facility for washing is provided.

Probably the greatest single factor in the development of this objective is the industrial arts teacher himself. He will be continually setting a standard and pattern for his students because of the position he holds, and the influence which he exerts on his students will be tremendous. His interests will, in turn, become his students' interests. The general tone of his attitudes and actions will be given much consideration as the student develops along these lines. Certainly any teacher needs to continually evaluate himself in the light of these characteristics.

(2) TO PROVIDE AN OPPORTUNITY FOR STUDENTS TO DEVELOP AN APPRECIATION FOR GOOD WORKMANSHIP, DESIGN, AND VALUE OF INDUSTRIAL MATERIALS AND PRODUCTS.

In order to appreciate good workmanship and design, the student must have an opportunity to compare good with bad and know what principles were used in making the classification.

During the planning and construction and also at the completion of the projects, teacher and student evaluations should be placed upon the quality of the various elements of design and workmanship. This should not be limited to the individual and his own work, but should also include group discussion in

connection with various problems. The construction problems handled in the shop will not provide sufficient experience, and other means should be used.

As the student develops his plans and drawings, he will be interested in studying books, magazines, and catalogs, and will have an opportunity to compare and arrive at judgments. The teacher should help in this study and should provide recommendations and counsel. During the construction stage of the problems the student will have opportunities to develop standards of workmanship and appreciation for the materials with which he worked. As he turns a shaft on the engine lathe to fit a certain size bearing, the measurement of one thousandth of an inch will become meaningful and he will learn to appreciate some of the problems involved in securing a good surface on a metal part.

Through the use of field trips, visual aids, and exhibits will come a further fulfillment of this objective. For example, through the showing of the film, "Romance in Industry," the grinding wheel and oilstone with which the student sharpens his plane and other tools will take on a new meaning in their relationship to industry. He will have a better understanding and appreciation for the important role manufactured abrasives play in the modern industrial scene.

Besides these so-called intrinsic values, he will learn to consider materials in regard to their value in terms of dollars and cents through the figuring of bills of materials and his school account. Every industrial arts teacher should provide for student experiences in this matter.

(3) TO PROVIDE AN OPPORTUNITY FOR THE STUDENT TO LEARN TO PLAN AND CONSTRUCT THINGS OF VALUE AND BEAUTY INVOLVING THE USE OF THE MORE COMMON HAND TOOLS, MACHINES, AND MATERIALS.

This objective provides for the development of creativeness and the ability to plan, as well as the development of skill. It is highly desirable that the student have the opportunity to create and develop his projects and problems and then work out a procedure and sequence of various processes involved in their construction and completion. The ability to plan will involve a knowledge of mechanical drawing and graphic representa-

tion. Study must also be given to the fundamentals of good design and their application to the project.

Good workmanship demands the proper use of tools and machines. The industrial arts laboratory provides an excellent opportunity for the development of these skills. Because of this opportunity, skill has often become the major aim of some teachers.

Skills should be considered as a relative term based on the experience and ability of the individual rather than on some adult standard. Not only is skill a relative term, but it has various applications. There are, for example, mental skills and physical skills and it would be difficult to develop either one separately. In shop work two common areas known as hand skills and machine skills are considered. Machine skills, while hand controlled, depend on power outside the human mechanism. Hand skills are those which involve muscular control, particularly with regard to the fingers, hands, and arms in handling tools. The operation of some of the popular and more common power-driven machines which are far from automatic is an example of a machine skill.

Mechanical skills have been retained as a fundamental in industrial arts, but they have become secondary in importance to the social economic implications. This concept includes more than the information or procedures that are involved in the development of a specific skill.

This does not give the industrial arts teacher license to permit a poor piece of work. It is still expected that a good job will be done in developing those basic skills which should be a part of every individual's education. The approach, however, must be different in that the teacher must work through boy and girl interests and problems to the end that his students will become acquainted with the world in which they are now living. The development of the traditional skills to complete a problem will be enhanced as the student has insight into the many implications which exist. The basic training along this line would involve a great variety of the more simple skilled processes most frequently occurring in the lives of people today. It has been the practice to base these skills on the usual trade or industrial divisions.

These skills should be practiced with the more common hand tools and materials, extending them as far as any particular situation seems to demand. In the case of those skills less frequently used, an experience sufficient to give a clear understanding of how the process is performed seems to be adequate.

The ability to perform the everyday tasks common to most boys and girls does not depend so much on a high degree of skill as it does on the general knowledge involved in the qualities and characteristics of materials, the methods and procedures involved in processes, and the basic principles which must be considered in construction.

(4) TO PROVIDE AN OPPORTUNITY FOR STUDENTS TO ACQUIRE THE NECESSARY INFORMATION FOR THE INTELLIGENT SELECTION, CARE, AND USE OF THE COMMON PRODUCTS OF INDUSTRY.

At the present time far too much stress is placed on money making ability and not enough on consumer skills which will result in people receiving more for their earned dollar. It is a fallacious idea that people will learn the art of buying and using the products of industry without some special help.

American people today spend many billions of dollars for thousands of items of food, clothing, shelter, home furnishings, and many others. Certainly the ability to spend these dollars wisely is an important consideration.

Consumer education has long been recognized as an objective of industrial arts by leaders in the field. Some very good materials have been prepared by the areas of home economics and business education, but little seems to have been done in the field of industrial arts. Most teachers feel that this is an incidental outcome of their classes. However, as important as the problem has become today, its development should not be left to chance.

The industrial arts laboratory offers a real opportunity to develop an intelligent, questioning attitude in the mind of the student in regard to the selection, care, and use of industrial products. It is obvious that the "consumer knowledge" should cover a very wide range of materials and it would be impossible to cover them all in the usual shop situation. However, it should not be confined to a few articles like tools, machines, and furniture, but should include many other items such as

home appliances, personal belongings, and other things about the home and farm.

The purpose should be to establish a careful, thoughtful attitude in order to avoid waste and to secure the greatest possible service from the things the individual buys and uses. Certainly the average individual will never have the financial ability to buy and secure all the material goods which he desires. Therefore, the solution to his problem may center around his ability to select, care for, and use wisely those things which he does have opportunity to obtain.

During the student's experience in the industrial arts department, he should develop ability in answering such questions as:

1. What constitutes good construction and design in furniture?
2. Is the finish one that will have desirable qualities?
3. What specific care will make an automobile last longer?
4. What are some considerations in selecting a refrigerator?
5. What are some of the points to consider in selecting a site for a new home?
6. What are common sizes and grades of lumber?

The problem of consumer education can be shared with other departments. As previously mentioned, the areas of home economics and business education have devoted attention to this matter. Surely here exists a real opportunity for coordination of effort by several areas of the curriculum toward a common problem. The industrial arts teacher should take advantage of the opportunities for integration that exist between industrial arts and other areas of the curriculum.

(5) TO PROVIDE AN OPPORTUNITY FOR THE STUDENT TO GAIN AN INTELLIGENT INSIGHT OF A TECHNOLOGICAL NATURE THROUGH WHICH HE MAY BE ABLE TO CONSIDER AND PLAN HIS DIRECTION FOR LIVING AND WORKING IN A DEMOCRACY.

This objective involves exploration, guidance, and vocational values. Every work experience provided in industrial arts classes brings with it an acquaintance with more and more materials and valuable experience in solving problems. Education for occupational efficiency cannot be disavowed by industrial arts teachers, but even in advanced classes, the em-

phasis should be conceived in broad, rather than in narrow terms.

In the early years of secondary education the foundations of economic understanding and a preliminary form of orientation should be established. This is clearly an integral function of general education, and the curriculum should include opportunities for student development along these lines.

The idea of exploration means not only a contact with a variety of tools, materials, and processes, but also study of occupational opportunities and interests. This principle of orientation has been extended to apply on all maturity levels. The industrial arts laboratory should afford the pupil the opportunity to explore his abilities and to test his aptitudes and interests in as many activities as possible.

The exploratory interests of boys and girls are motivated by curiosity about things, how they work, how they are made, and what purposes they can be made to serve. These interests will begin to crystalize into desires which are definitely vocational as the pupil advances to higher educational levels. Consequently, we find him evaluating each school subject according to the use it appears to have in a very practical world. In general, he is encouraged in this by the emphasis which parents and teachers place on the "life-work" or a vocation. The industrial arts shop in the senior high school must answer, in part, questions as to practical problems related to occupational life if it is to hold the interest of the student.

It would be difficult to conceive of any program of secondary education that did not attempt to give vocational direction to the pupils who come under its influence. Spelling, reading, writing, arithemtic, and bookkeeping can be considered as most definitely vocational if and when they are used to prepare the student for a job as a bookkeeper. Nevertheless, one seldom thinks of these as vocational subjects. This is also true of all the subjects that comprise the field of industrial arts. As a part of the general education program of any high school, many industrial arts subjects may lead to a definite vocational study.

Vocational education means preparation for an immediate wage earning occupation, and any motive of this nature that is present among students in the early years of high school is

apt to be rather vague. This is especially true as examined in the light of present conditions which place the entrance into occupational life well beyond these years. However, interest in industrial affairs in general is pronounced by boys and girls of this grade level because they are beginning to realize their individuality and the importance or desirability of associating themselves with broad general fields of occupations. They find themselves surrounded by great organizations involved in manufacturing, communication, and transportation and are highly interested in problems involving themselves as they fit into this industrial scene.

The industrial arts teacher should so organize the activities and instructional materials in the industrial arts laboratory that some of the following questions might be answered in the minds of his students. These answers might be secured in part through reading, excursions, job participation at school or at home, experimentation, investigation, and other activities of an exploratory nature:

1. How does the occupation contribute to the welfare of society?
2. How has the occupation grown and changed?
3. What are the main branches, departments, or types of work?
4. What things are actually done by the workers or personnel?
5. What are the opportunities for learning, for advancement, for initiative?
6. What are the indications as to the future changes and developments in the occupation?
7. What educational training is necessary or desirable?
8. What kinds of work or experience serve as a background?
9. What other occupations are similar or related to this one?
10. Does the occupation help the worker to have a good life as a citizen and an individual?

(6) TO PROVIDE AN OPPORTUNITY FOR STUDENTS TO DEVELOP DESIRABLE RECREATIONAL AND AVOCATIONAL ACTIVIES.

As has been previously stated, one of the great problems which faces our democracy today is the worthy use of leisure time. This is true not only of adults, but of our girls and boys as well. Leisure time activities can be classed in three groups:

1. Those which are harmful, both physical and mental.
2. Those which are neither particularly harmful nor result in any value.
3. Those which are definitely *re*-creational and valuable to the individual's well being.

The industrial arts teacher must assume a real share of the responsibility of helping students select the kind of activities that might be classed in the third group.

Activities in the industrial arts laboratory result in the development of recreational activities, whether or not it is planned for. However, the opportunity of the industrial arts teacher in this matter is so great that a definite plan should be followed in promoting desired activities outside of school. As the student develops skills and abilities in a certain area of work, he in turn will develop an increased interest in those activities. In general, people like to do the things over a period of time that they know about and can do well. An individual will not long continue to pursue an activity in which he is not rewarded to some degree by the satisfaction that comes from accomplishment. Thus, it would follow that a start has been made in the promotion of outside activities and interests if the teacher has developed in the students some degree of skill in the various activities undertaken in the shop.

Besides these skills and interests offered in the shop, the teacher must make further provision for the promotion of desirable leisure-time activities. Some of the following might serve as suggestions and be used as a part of a promotional scheme:

1. Make available to the students in connection with the planning center, books, magazines, and catalogs dealing with hobbies and home workshop activities.
2. Display pictures of student-developed home workshops.
3. Permit students to build home workshop equipment as a part of their regular class work.
4. Visit home workshops and offer suggestions for improvement, etc.
5. Present home workshop projects in the school display case.
6. Promote hobby club through which students may develop new interests.
7. Secure and provide various exhibits which will promote new interests and ideas.
8. Promote adult recreational activities through evening school classes.

(7) TO PROVIDE AN OPPORTUNITY FOR STUDENTS TO BECOME FAMILIAR WITH AND INTERESTED IN MAINTENANCE AND IMPROVEMENT IN THE HOME AND FARM.

Family relations are basic to our American democracy and are recognized in the cardinal principles of our education. The care and maintenance of the housing facilities of the family are involved in this problem.

Industrial arts can contribute much to this concept by providing for the development of practical skills, desirable attitudes, and interests related to the improvement, care, and use of the home and its equipment. The increasing amount and the complicated character of the equipment of the average American home and farm makes for growing concern in this matter. Found as standard equipment in our homes and on our farms today are such items as furniture, radios, refrigerators, oil burners, air conditioning equipment, automatic heating devices, washing machines, electric water pumps, electric motors, complicated farm machinery, mechanical milking equipment, feed grinders, and a host of others, all of which require an increasing amount of care and maintenance in their efficient operation and use.

Such an objective as the one at hand could be attained through areas in home mechanics or farm mechanics which deal directly with problems of maintenance. However, its development should not be limited to these areas but should be considered in other areas such as woodworking, wood finishing, various metal areas, and electricity. For example, a part of the experiences in electricity should be devoted to simple house wiring problems involving fuses, motors, line loads, and circuits. Some of the other experiences should include maintenance of light fixtures, extension cords, refrigerators, vacuum cleaners, etc.

Developing these interests, attitudes, and skills are important to the student's present family life and will mean much as he becomes an adult and establishes his own home.

Activities aimed at the development of this objective should be a part of the student's work in the industrial arts laboratory and might also involve actual problems undertaken in the home. It must be understood that some of the repairs needed around the home might be of such a character as to involve the services of an experienced mechanic or repairman. However, many of these problems could well be handled by the members of the family and might involve some of the follow-

ing: repairing extension cords, replacing fuses, sharpening knives, driving nails and screws involved in the repairing of woodwork, painting, varnishing, staining, gluing of broken chairs and other furniture, cleaning of traps under sinks, installation of certain plumbing fixtures, cleaning of gas burners, and replacement of belts. These are only a few of the many things that all Iowa boys and girls, whether they live in urban communities or on the farm, should be able to contribute as a part of their share to family living.

(8) TO PROVIDE AN OPPORTUNITY FOR STUDENTS TO DEVELOP A BODY OF INFORMATION AND TRAINING WHICH WILL AID THEM IN AVOIDING ACCIDENTS TO THEMSELVES AND PREVENTING ACCIDENTS TO OTHERS.

Although safety education should have its origin in the elementary schools, we must accept the fact that the secondary schools also have a real contribution to make in connection with this problem.

The need for a knowledge of accident prevention goes beyond safety in the school shop itself. Those who will later become industrial employees and students generally need to develop a safety consciousness which will protect them against accidents for the rest of their lives.

Safety education is generally thought of as being the training of students to avoid accidents to themselves and to prevent accidents to others. This phase of modern education means teaching the student to adjust to our civilization, preparing him to meet successfully our increasingly difficult situations of life. He must, somewhere, acquire a certain amount of information, the ability to apply this information to good, sound, concrete situations, and the habits which will make the application of knowledge to situations automatic.

While safety has an important technical side, in its deeper sense it is the acquiring of an attitude toward life. The safety habit when established has a practical protective effect, but also important is the effect upon character that is produced.

The industrial arts teacher should provide the situations that will develop desirable attitudes and habits involved in safety. Some of these might include:

1. Give adequate instruction for the safe use of all equipment.
2. Have the students help develop safety rules and aid in their enforcement.
3. Have students help plan and lay out safety zones for machines.
4. Study safety guards and devices used on machines in the laboratory.
5. Visit factories and observe safety measures.
6. Study standards for adequate lighting, heating, and ventilating.
7. Study literature published by industrial concerns and insurance companies.
8. Use motion pictures, slides, posters, lectures, etc.

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Chapter II

ADMINISTRATIVE CONSIDERATIONS

Industrial arts is a vital part of a well-rounded high school program and should be treated as any other regular subject-matter field. Such treatment is necessary in establishing industrial arts in its proper place in the school curriculum.

1. SCOPE

This handbook is intended primarily for industrial arts instructors in the secondary schools of Iowa. However, it should be recognized that industrial arts is desirable at all levels of the public school program and that work in the high school is a continuation of that in the earlier grades.

Elementary Grades. Industrial arts activities provide rich experiences for children. In grades 1-3, their interest is centered around the home, school, and neghborhood. The room teacher can readily handle the work, as the content is simple, the skills few, and the equipment limited. In some schools these activities form a core around which other fundamental subjects are introduced. Industrial arts and fine arts are closely correlated at this level and should provide opportunity for creative activity. The child should become acquainted with paper, wood, textiles, clay, and other simple materials and understand how they are involved in the problems of food, clothing, and shelter. The activities are developed in the regular class room.

In the grades 4-6, this study should be extended to include information about the broad areas of transportation, manufacturing, and construction. The industrial arts activities will serve to enrich and interpret the content of other subjects. Many of the activities may be developed in the room and under the direction of the room teacher. Some, however, will require additional space and equipment, and a special activity room is desirable. This room needs only simple equipment and can serve several groups. The services of a special teacher in this area are desirable to assist the regular room teacher with some of the activities.

Junior High School. Here it is desirable for the students to come under the direction of a teacher especially trained in the field of industrial arts education. The work consists of a wide variety of experiences in a number of fields. Emphasis is placed on knowledge, understanding, and appreciation.

"Industrial arts, as a part of general education, in these years (a) provides information regarding industry and workers; (b) reveals employment opportunities offered by industry; (c) satisfies the boy's and girl's desire to create useful things; (d) develops hobby and handy-man interests and abilities; (e) contributes to the tastes and judgment of the prospective consumer; (f) develops interest and ability in home repairs and maintenance; (g) affords practice in safety related to the school, home, and industry; (h) gives opportunity for cooperative effort in groups; and (i) illustrates and vitalizes the academic subjects."[1]

Senior High School. At this level, the student who enrolls in industrial arts courses, elects advanced work from a number of broad general fields. It provides students with opportunities for advancement toward a chosen goal, and builds upon the broad over-view courses presented at the junior high level. Course content may vary according to the particular needs of the individual student.

Adult. One of the important needs of adults and out of school youth is the development of recreational interests. Facilities should be provided for the learning or exercise of skills and knowledge in a great variety of avocational activities. The industrial arts program can, through after-school and evening classes, help accomplish this.

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[1]*INDUSTRIAL ARTS, Its Interpretation in American Schools,* U. S. Dept. of Interior, Bulletin 1937, No. 34, page 41.

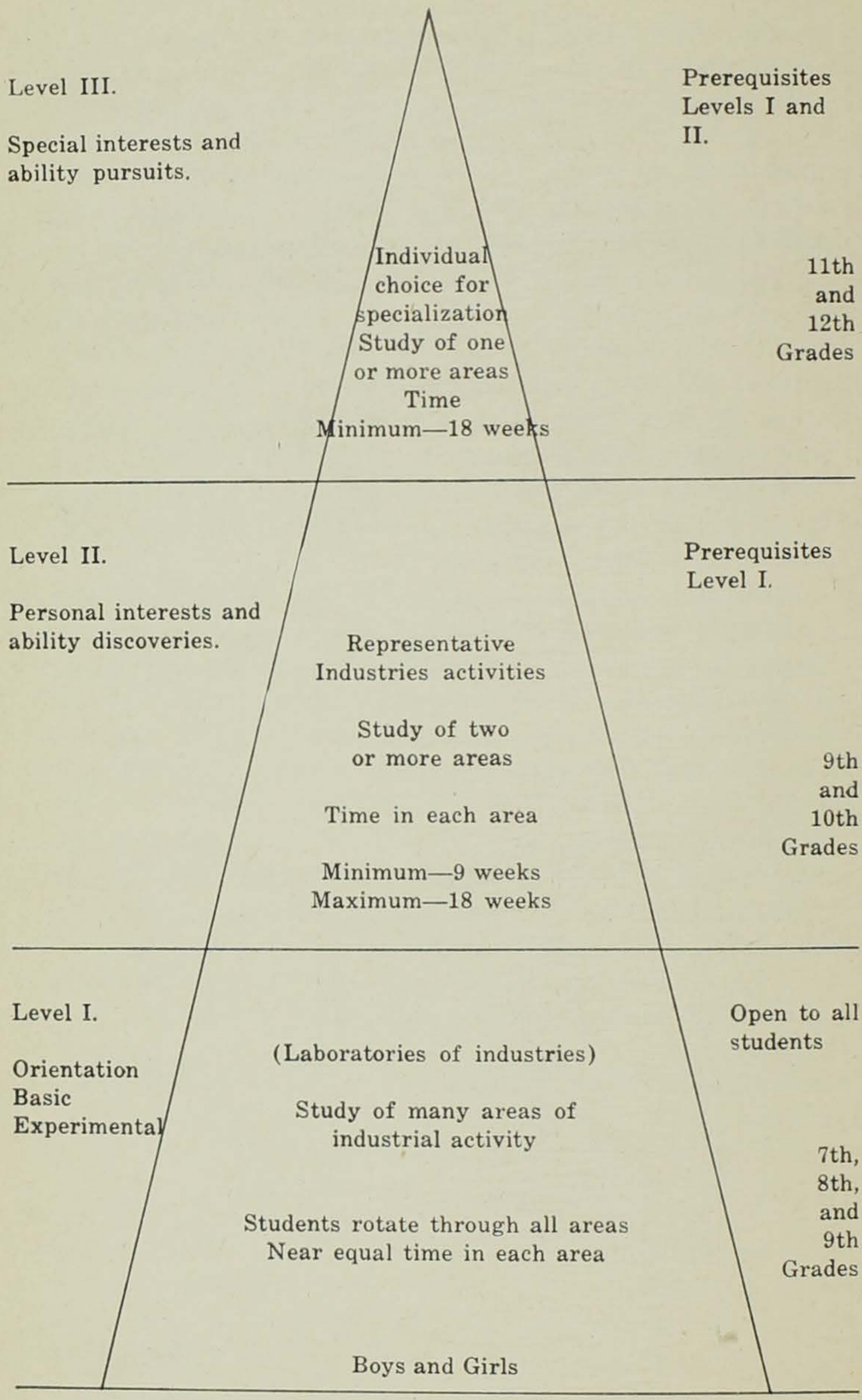

Figure 1. Graphic Triangle of a Minimum Industrial Arts Program, Indicating Grade Placement

Scope Limited in Iowa. More than two-thirds of the high schools of this state have an enrollment of less than one hundred students. These schools usually have a limited offering of industrial arts, seldom penetrating below the ninth grade. Most of the larger town and city high schools have well-developed programs on the junior high level and a few have developed an elementary program. Every school is encouraged to increase the scope and range of its industrial arts program as much as conditions permit.

2. GRADE PLACEMENT

In order to develop an understanding of the desired outcomes of industrial arts in the various grades of the secondary school it may help to first consider three levels of experience that can be provided. Figure 1 presents a graphic representation of these three levels.

Level I. This level includes the first experiences of the students in a formal course of industrial arts. It provides orientation experiences in a number of activities. At this level more areas and less depth is desirable. There should be opportunities to try out various personal abilities, interests, and aptitudes.

A wide range of activities can be presented through work in planning and drawing, woodwork, bench metals, electricity, crafts, elementary mechanics, and others. Schools just beginning a program might well select planning and drawing and two or three other areas which seem most desirable and can be successfully carried on.

In the small high school this level can be handled in the "one-teacher" situation, with the students spending about equal time in each area and rotating through them on an individual basis. Twice as many work stations should be provided as the number in the largest class.

In the larger schools it is possible to have separate laboratories for each major area of activity. The classes at this level can be routed through these laboratories on a near-equal time basis.

Level II. This level may be elected by students who have completed level I. They should have freedom of choice of those activities which will be most beneficial to their imme-

diate needs. Past experience and performance will help in making these selections.

The activities pursued should give the student further opportunities for individual exploration of personal interests and abilities. The suggested minimum time in any selected area should be about nine weeks with a maximum of eighteen weeks.

Besides basic skills and information the student should develop a better appreciation of good craftsmanship and design, individual efficiency, desirable attitudes, habits, and character traits.

The small "one-teacher" situation can easily provide for this level of work. In larger schools the students should be enrolled in semester courses offered in the laboratories devoted to a single major area of activity, such as wood, drawing, metals, electricity and others.

Level III. The objective of level III is to provide the opportunity, after completing levels I and II, to develop some degree of specialization in the line of the student's major interest whether this be prevocational, avocational, or some other interest.

The length of time spent in any one activity area should be longer, probably varying from 18 to 36 weeks. The student can be expected to develop considerable skill and technical information in addition to other outcomes of the industrial arts program.

3. TYPES OF INDUSTRIAL ARTS LABORATORIES

There are several types of laboratories that can be used to develop the total industrial arts program.

General Industrial Arts Laboratory (commonly referred to as a composite general shop, comprehensive shop, multiple activity shop, or laboratory of industries).

The chief purpose of this type of organization is to provide with a maximum amount of equipment a broad general and practical educational training through real life experiences in typical industrial activities of fundamental importance and interest to youth.

The experiences usually are selected on the basis of student interests, needs, and ability to execute, and include a number of representative industrial activities arranged in a unified course.

The various activities are in operation at the same time and under the guidance of a single instructor.

This type of organization is especially well adapted to the small high school which might provide equipment for general drafting and planning, general metals, general woodwork, practical electricity, home mechanics and perhaps general crafts.

In this laboratory the purposes of industrial arts are best achieved if the selected activities are organized and conducted so that each student will receive some training and experience in each one represented. Proper balance of equipment among the areas and efficient class organization are essential to success.

General Area Industrial Arts Laboratory (commonly known as the general unit shop).

This type of organization offers experience in a single general area of industrial activity such as woodwork, metal work, electricity, etc. The general woodwork laboratory might include tools and equipment for bench woodwork, machine woodwork, wood finishing, wood turning, upholstery, and wood carving. The general metals laboratory may provide equipment and facilities for art metal, bench metal, sheet metal, machine tool, forging, foundry, and others.

The general area laboratory is more limited in scope than the general industrial arts laboratory, but it provides for more specialization and is considered easier to organize and operate. Its greatest adaptation is found in the larger school systems where it is possible to have a number of laboratories of this type, each representing a major area of activity. Here classes may rotate through the various area laboratories for basic experiences and still have adequate facilities for those seeking advanced work in their junior and senior years.

Single Unit Laboratory (commonly called the unit shop).

The work in this type of laboratory is confined to a single industrial activity. Examples would include separate laboratories devoted to specialized work in such areas as sheet metal, machine tools, cabinet making, welding, architectural drafting and others. The equipment is more specialized than that in the general industrial arts laboratories. Single unit laboratories are generally identified by one activity taught in one room by one instructor.

The single unit laboratory offers opportunity for a higher degree of specialization and is found in larger school systems where many industrial courses are taught, each in an especially equipped shop and staffed by a teacher specifically trained in that area. When instruction becomes specialized to the extent indicated here the objectives may include those of trade training.

4. FACTORS DETERMINING THE TYPE OF PROGRAM

Those responsible for planning the industrial arts program should give consideration to the following factors:

1. Size and character of the school district.
2. Age and background of the students.
3. Objectives to be attained.
4. Funds available for equipment and operation.
5. Provisions for adequate housing.

Small schools cannot afford to offer industrial arts through the use of several general area laboratories as is commonly done in city school systems. Here the choice must be a single industrial arts laboratory that would be used to its full capacity, offering a variety of experiences and activities pertinent to the needs of the students.

Occupational activities of the community may be reflected to some degree in the program and emphasis may well be given to the most important local industries. If the community is one emphasizing agriculture, the industrial arts activities and projects should reflect more of the farm life. We should not, however, lose sight of the fact that industrial arts in its own right is highly desirable and beneficial to all students, regardless of what may be their future occupation or where they live. This implies that a variety of experiences in many of the major areas of industry must be provided.

Those responsible for planning an industrial arts program should make an intensive study of housing, funds, materials, and labor, and available equipment. Then in the light of their findings plan a program to make the most efficient and practical use of these assets. Sometimes the small school system may have to make their start with a part-time instructor in industrial arts in an inadequate shop with a minimum of equipment and develop the program as means become available. More areas and less depth is better than entirely eliminating

any area. At least three or four major areas of activity seem to be essential to provide a significant program.

5. SUGGESTED INDUSTRIAL ARTS PROGRAM FOR HIGH SCHOOLS OF IOWA

Even though the physical aspects of the laboratories may vary in the different sized high schools, the broad curriculum offerings should be somewhat similar with details adjusted to meet specific local needs and community interests. Small high schools should aim to establish at least a minimum program in industrial arts, while the larger ones can add much enrichment and depth to their present program.

Industrial arts is found in most of the high schools of the state, but the administrative practices and standards of teaching do not follow parallel patterns within a given group or type of program. The physical layout and equipment of some smaller schools greatly surpass that of a much larger school. A small school may have a much better prepared teacher than a larger school, but the physical layout and equipment will not permit him to do the type of work he is capable of doing. One school may have considerable equipment for a diversified program, but the interest of the instructor may be narrowed to one or two activities. Other examples of variation could be cited. An honest and determined effort should be made on the part of teachers, supervisors, and administrators to make the program for industrial arts in Iowa as functional and educational as the basic philosophy indicates.

It is the aim of this outline to suggest broad standards that are possible of attainment in the various schools and still provide for considerable freedom and initiative regarding the industrial arts program of any particular school. A great many variables, both human and environmental, make it practically impossible to present and analyze effectively all of the necessary details which demand consideration in setting up a course in industrial arts. Therefore, the details of the areas of activity are left to the good judgment of the individual instructor or supervisor.

The average sized Iowa public school system depends on one general laboratory to handle its industrial arts program. One industrial arts teacher is employed and no industrial arts

courses are offered below the ninth grade. It is for this type of situation that the following program is planned. Larger or smaller schools will need to make adaptations.

Subject	Area-Time Division	Number Semesters	Semester Credits	Periods per Week	Grade
Industrial Arts I Rotating orientation and exploratory course	Near equal time in each area offered	2	2	10-40 min. or 45 min. or 5-60 min.	9th plus students in upper grades desiring Ind. Arts
Industrial Arts II Personal interests and ability discoveries	Minimum—9 weeks; Maximum—18 weeks	2	2	"	10th plus students in upper grades desiring a second year in Ind. Arts
Industrial Arts III and IV Special interests and ability pursuits	18 weeks or more	2-4	2-4	"	11th and 12th

Figure 2. Grade placement, time allotments, and credits.

INDUSTRIAL ARTS I

This level of industrial arts presents the basic fundamentals of each area considered desirable to develop elementary skills, consumer knowledge, simple technical information, and to inspire individual interest and test personal aptitudes. It is recommended that all students in each class rotate on an individual basis through all areas selected. Therefore, it is quite essential that approximately twice as many work stations be provided as there are students in each class to allow for individual differences and the necessary flexibility in rotation procedures.

SUGGESTED MINIMUM PROGRAM—General drawing and planning and three other areas

General Drawing and Planning (Rotating)
free hand sketching, orthographic views, pictorial views, dimensioning and lettering simple working drawings, instrument drawing, designing and planning projects.

General Woods (Rotating)
hand tools, simple construction, wood finishing, use jigsaw, bandsaw, lathe.

General Metals (Rotating)
art metal, sheet and bench metal, wrought iron, and some work with hot metals, welding and foundry.
General Electricity (Rotating)
simple projects involving basic principles and problems.
General Crafts (Rotating)
leather work, plastics, ceramics, bookbinding and weaving.
Home and Farm Mechanics (Rotating)
general home and farm maintenance problems, simple repairs of electrical fixtures, plumbing, doors, windows, plaster, concrete, utensils.

INDUSTRIAL ARTS II

Courses offered on industrial arts II level should probably include the areas selected for the rotating program of industrial arts I. The time element most satisfactory for each area will vary with the amount of depth penetration desired. It is suggested, however, that a minimum of nine weeks and a maximum of 18 weeks be spent in each area selected by the student.

PREREQUISITES—Industrial Arts I.

SUGGESTED PROGRAM—Work in two or three of the following areas:

Drawing
sketching and instrument drawing, lettering and dimensioning, auxiliary projections, sectional views, working drawings, pictorial drawings, machine drawing, developments for sheet metal, house planning.
Woods
hand tools, machine tools, wood finishing, pattern making, and carpentry.
Metals
sheet and art metal, bench metal (mild steel and wrought iron), machine tools, welding, foundry, forging.
Electricity
basic principles, electric motors, illumination, radio and other communication, and construction of simple electrical projects.
Crafts
leathercraft, plastics, ceramics, bookbinding, photography and jewelry.
Home Mechanics and Farm Mechanics
repairing electrical appliances, painting and finishing in the home, water supply and waste disposal, the home workshop, home planning

and remodeling, how to select furniture and utilities and care and repair of farm machinery.

Transportation (auto mechanics and aircraft)
automobile maintenance and service problems involved in the care of finish, tires, brakes, cooling system, ignition system, and body. Dis-assembly and study of dry motor blocks, simple aircraft engines and air frame construction, model construction.

INDUSTRIAL ARTS III AND IV

Sequences might be composed of any of the following courses depending upon the available equipment of any particular school, the teaching personnel, and the local needs and interests. It is recommended that schools plan for future offerings in all courses suggested here, plus any others which seem desirable.

PREREQUISITES—Industrial Arts I and II.

SUGGESTED PROGRAM

General Mechanical Drawing
working drawings (detail and assembly), perspective, machine, sheet metal, architectural, aircraft, graphs, charts, maps, tracing, and reproduction.

Woods
hand and machine woodworking, carpentry, production woodwork, furniture design and construction, wood finishing, upholstery, and pattern making.

Metals (cold)
advanced bench and sheet metal, machine tool, lathe, milling, shaping, grinding, broaching, planer, and precision layout.

Metals (hot)
forging, welding (gas, arc, spot), foundry, heat treating, and design in metals.

Transportation (auto mechanics and aircraft)
automobile maintenance and repairs, advanced study of times, brakes, cooling system, ignition system, body repair, dis-assembly and study of dry motor blocks, aircraft engines and air frame construction, model construction.

Electricity
radio, television, radar, telephone and telegraph, illumination, and advanced repairs of electrical devices.

Crafts
advanced design in materials, plastics, ceramics, jewelry, weaving, leather, and silk screen reproduction.

6. TEACHER IMPROVEMENT

The teacher is by far the most important single factor determining the success of an industrial arts program. Qualifications have progressed from the early days of manual training, when it was only necessary for the shop teacher to be a skilled worker or tradesman, to the present time when the qualified industrial arts teacher is expected to have an educational background comparable to any of the other teachers in the curriculum. In addition to this educational background, he should have other qualifications of which a few are as follows:

1. A genuine interest in things mechanical.
2. Good muscular coordination and a wholesome attitude toward physical labor.
3. Expert craftsmanship in at least one major industrial arts area, and proficiency in several others.
4. A wide range of information concerning tools, materials, processes, products, and problems of occupational life in industry.
5. Ability to distinguish between poor design and good design in industrial products, and to design shop projects which are structurally sound and aesthetically pleasing.
6. A sense of neatness and orderliness with respect to shop housekeeping.[2]

There has never been a time when the industrial arts teacher has been offered the incentive for self improvement that is his today. The last few decades have seen more and more emphasis placed on this curriculum area. Progress can be even greater in the years immediately ahead.

Every industrial arts teacher should develop a philosophy of professional growth. Among other things, this philosophy should foster the development of an "experimental attitude," which will allow him not only to improve his old methods, techniques, and skills, but also develop new ones. He must be aware of changes and willing to experiment with them where they further the cause of education. The progressive industrial arts teacher will study trends in the social, economic, and technical progress of the world, and thus prepare for changes that affect his field.

Any teacher who desires to improve his teaching must, at regular intervals, take time for self analysis. There is no better way to diminish personal egotism and develop a more sympa-

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[2]*Industrial Arts Handbook*, Bulletin 7B, 1945, Missouri Public Schools, Jefferson City, Missouri, p. 43.

thetic understanding towards the faults and peculiarities of those with whom he works. A personal check list should include such points as:

1. Personality and character.
2. Point of view.
3. Professional growth.
4. Teaching methods.
5. Attitude toward administration and other teachers.
6. Mannerisms, speech, facial expression, posture, etc.

The industrial arts teacher should take advantage of every chance to function in a professional capacity. Through local, state, and national industrial arts associations and clubs, he can keep in close contact with other teachers and leaders in the field. There is no better way to exchange ideas and interests if the organizations are functioning properly. If these things have not been outcomes in the past, then there is a real challenge to the teacher to influence his organizations that these may be the results in the future.

There is much that the teacher can gain through the conscientious participation in local and county conferences and teachers' meetings. It would be highly valuable for a teacher to spend several days during the school year visiting in one or more outstanding industrial arts departments over the state. This will lead to much self improvement as well as an improvement and unification of the state program as a whole.

There is a wealth of general and professional literature available to the industrial arts teacher. He should read regularly the professional magazines in his field. There are books written especially for the field of industrial arts, and the teacher should make these a part of his personal library. In connection with this the committee suggests a study of the professional literature listed in the appendix.

Many teachers find that the teacher training program to which they were exposed some years ago has not given them all the background they need for a modern educational program. As a result, we find more and more teachers attending summer schools, both on the graduate and undergraduate level. The progressive industrial arts teachers should enroll not only in courses directly related to his field but should also consider those offered in psychology, sociology, economics, and guidance and counseling.

7. TRENDS IN THE PROGRAM

The emphasis that is being placed on the industrial arts program at the present time should result in some of the following immediate improvements:

1. More adequate housing and equipment.
2. Extended offerings both in number and quality.
3. Extending the industrial arts program into the junior high and elementary grades.
4. Industrial arts classes for girls as well as boys.
5. More adequate provisions made for caring for individual differences in interests, abilities, and needs.

For some time there has existed a growing trend towards a horizontal integration of curriculum areas in the secondary field. In industrial arts, this has resulted in what is commonly referred to as the "arts and industries" program. Essentially, this program brings together the industrial arts and the fine arts. Figure 15 shows the equipment layout for such an organization. The program would be handled by two teachers, one in industrial arts and one in fine arts. Beginning classes have opportunities in most of the areas represented. Advanced students, although concentrating in one or two areas, have available the counsel of both the fine and the industrial arts teachers.

Another trend seems to be that of organizing the content material of industrial arts under the broad general headings of power, transportation, communications, construction, and manufacturing. Such a program might not require much change in the physical set-up of the well equipped general industrial arts laboratory. The greater change would be in the extending and broadening of the content organization.

Chapter III

ORGANIZATION PROBLEMS

1. STUDENT PERSONNEL ORGANIZATION

As the areas of activities presented in the industrial arts laboratory have increased in number and scope, it has been expedient for the teacher to assign many of the clerical, preparatory, maintenance, and general routine duties to the students. This plan, which has been organized in varied ways, is generally referred to as a student personnel organization.

Pupils can receive valuable experience through participation in such a plan. Some of the basic values derived from a carefully planned organization are as follows:

(1) Broadens pupil development.
(2) Increases interest in work.
(3) Relieves the instructor of routine work and allows more time for instruction.
(4) Shows the pupil the value of responsibility.

In order to meet these needs, industrial arts teachers have developed a plan whereby the pupils, under appointed or elected leaders, perform various duties. At certain designated times, these assignments are rotated to give all pupils an opportunity to occupy these positions of leadership.

Student personnel organizations may vary according to many conditions that prevail in the laboratory, such as the number in class, kind of equipment, areas of work, and ages of the students. An effective and worthwhile organization calls for careful planning on the part of the instructor. Because of the many variables that exist, no one plan could possibly fit all situations. The following suggestions are presented only to serve as examples in describing some of the methods used in setting up a student personnel organization.

Positions and Duties. The industrial arts instructor must give careful consideration to the positions he will include in his student organization. The positions should be selected after a careful study and listing of the detailed duties that need to be performed in any given situation. The instructor should use care that he does not list duties and assignments

that are impractical or unnecessary. The entire plan should be kept as simple and free of complications as possible.

At the outset, the plan must be well presented to the students and the justification for its use clearly defined. The success of any student personnel organization will depend to a large extent upon the general attitude the students hold toward the plan.

A formal listing of the duties of each position should be made. These should be studied by the class and posted in the areas most directly concerned. These lists should be checked and revised as need for change is felt by the students and instructor. Any given duty should be performed, not necessarily because it is included in the list of assignments for a certain position, but because it is important and necessary to the successful operation of the laboratory.

The following are some of the positions, with a list of duties, that might be found in an industrial arts laboratory:

SUPERINTENDENT

(The position of superintendent is the most important position in the shop. Treat it in such a manner that it will tend to encourage students under your supervision to become leaders and followers in school and society.)

(1) Arrive in the laboratory as soon as possible after the bell rings.
(2) Obtain keys from the instructor and unlock the project storage case that belongs to your class. Unlock the tool cabinets for the tool foreman; be sure he is there to check the cabinets.

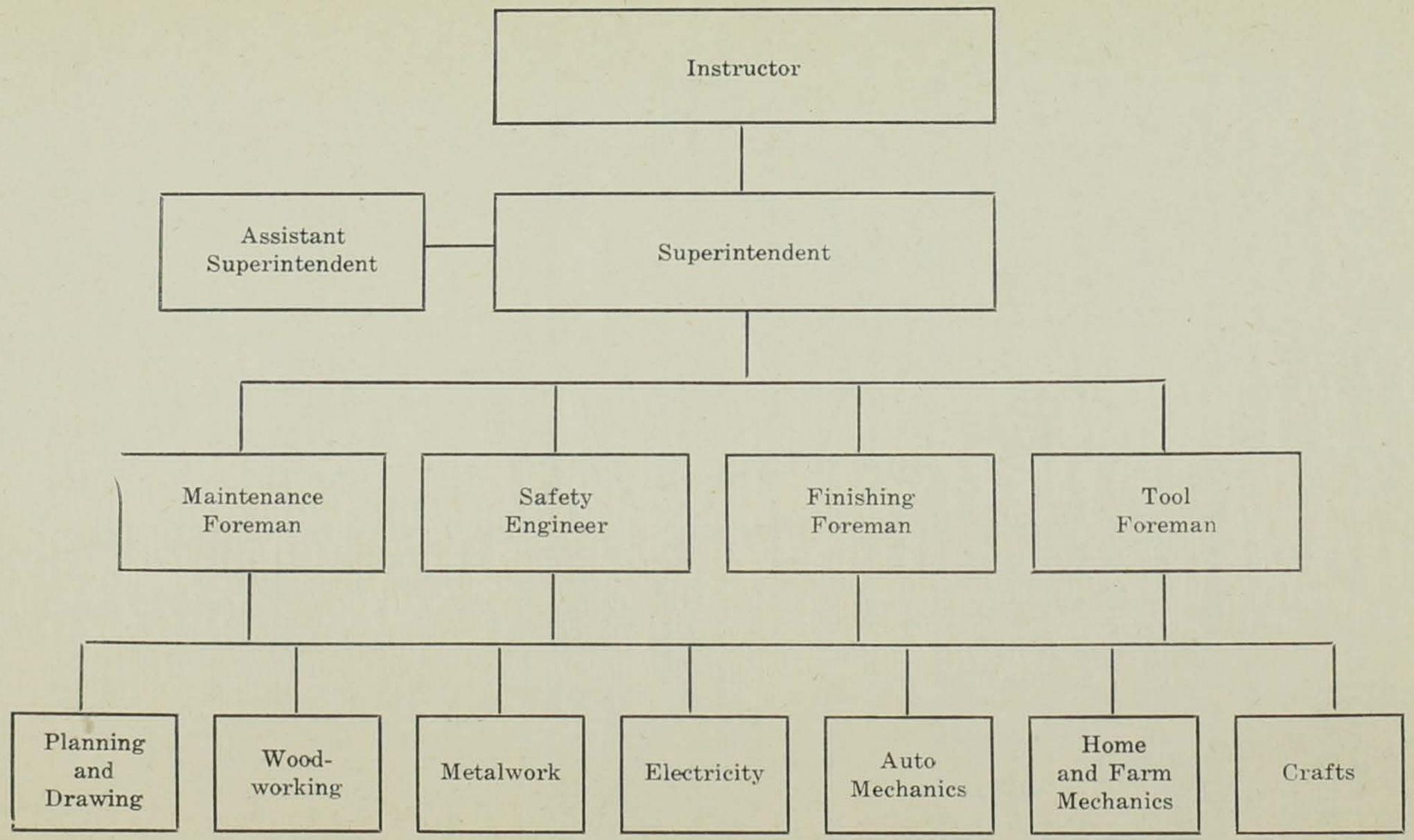

Figure 3. Student Personnel Organization for a Large Industrial Arts Department.

(3) Turn on the switches for the machines to be used in your section.
(4) Close the shop door when the tardy bell rings and see that it is kept closed during the working period.
(5) Take charge of the shop and assist the instructor in any way possible. Instruct students in proper methods of work and help them when needed.
(6) See that all of your foremen are wearing their aprons and taking care of their assignments. Select a substitute for any officer that is absent.
(7) Fill out the superintendent's report; check at the beginning and end of the hour.
(8) Note any visitors in the department and show them the work in progress.
(9) When the clean-up bell rings, see that students clean up promptly. Pull all switches and lock the switch box.
(10) During the clean-up period, check your foremen at their various jobs. Lock the tool cabinets as the tool foreman completes his check. Close and lock project storage locker. Close and lock stook room. When all is in order, turn keys to instructor.
(11) The position of superintendent is a full time job. You will not be expected to complete any work on your own project during the week you hold this position.

ASSISTANT SUPERINTENDENT

(1) Arrive in the laboratory as soon as possible after the bell rings. If the superintendent has not arrived or is absent, take over his assignments.
(2) When the tardy bell rings, obtain the roll book from the instructor's desk and check the attendance.
(3) You are an assistant to the superintendent and should check with him from time to time during the working period. He may assign you the duties of a foreman who is absent.
(4) During the working period, you should have considerable time to apply to your own project. This will vary from time to time.
(5) Watch the clock and ring the clean-up bell five minutes before the end of the period. Put away your own tools and materials before you ring the bell so that you may help the superintendent during the clean-up period.
(6) During the clean-up period, see that books and magazines are returned to their proper shelves. You are responsible for checking the order of the planning room. See that drawing equipment is clean and in order. Straighten chair and table arrangement.

HAND TOOL FOREMAN

(1) Arrive in the laboratory as soon as possible after the bell rings.
(2) The superintendent will unlock the tool cabinets for you. Check the cabinets carefully as they are unlocked and report any disorder or missing tools to the instructor.

(3) Tools in the precision tool cabinet in the machine tool area are to be used only with the instructor's permission.
(4) During the working period you should clean any cabinet that is in disorder. Check with the instructor before making any tool repairs.
(5) During the working period you will probably have time to work on your project; however, you must keep in mind that your first responsibility is toward the hand tools in the shop. You should set aside your own work several minutes before the clean-up bell.
(6) During the clean-up period, see that tools are returned to proper cabinets and holders. Check conditions of tools and see that grease is removed from wrenches, files cleaned, shavings removed from planes, etc.
(7) When cabinets are complete, close and lock. Report O.K. to the superintendent.

FINISHING FOREMAN

(1) You are responsible for the appearance and condition of the finishing room and the gluing and assembly area.
(2) Check carefully at the beginning and end of the working period, and see that supplies are in good condition and in their proper places. Replace paper towels that have become soiled.
(3) During the working period you should check several times to see that materials are used properly and not wasted. Each student should clean up the materials he has used and return them to their proper places.
(4) You are responsible for the arrangement of the bar clamps and hand screws. Stock that is in the clamps should be neatly arranged inside the zone provided for that purpose.
(5) The metal container is for rags. Have students return the rags they have used and place them in it. Oily and dirty rags should be placed in the metal container on the floor.
(6) During the clean-up period, check supply shelves and see that all brushes and finishes are in their proper places. Report any supplies that are needed to the instructor. If necessary, replace the newspapers on the finishing table and glue table.
(7) When all is in order, report O.K. to the superintendent.
(8) During the working period, you should have considerable time to apply to your own project. The amount of time that you will have to devote to your responsibility will vary directly with the number of students using the finishing room and assembly area.

SAFETY ENGINEER

(1) You are responsible for the safety of: first, the worker; second, the tools and machines; and third, the materials being used.
(2) Remind the careless students of the safety rules set forth in class, and if they continue as before, report them to the instructor at once.

(3) Look for loose clothing, ties, etc., that might become entangled in the machinery and endanger the workman.
(4) Tools should be properly located in the tool trough when not in use, planes on their sides, etc.
(5) See that only the operator of the machine is in the safety zone. The machines must be properly guarded. The guards may be removed only with the permission of the instructor.
(6) You are responsible for the condition of the student storage locker. Straighten and clean, if necessary, during the working period. During the clean-up period, see that students stack their materials neatly on the rack, and see that all vises are closed with handles down. Check the valves on the welding tanks and the blast furnace and see that they are closed. Report O.K. to the superintendent.
(7) The amount of time necessary for you to handle your responsibility as safety engineer will vary. There will be times when you can work on your project. However, you must not become so engrossed that you will forget the important responsibility assigned to you.

MAINTENANCE FOREMAN

(1) The maintenance foreman will be responsible for the cleanliness of the laboratory at the end of the work period.
(2) Check towel dispenser and if towels are needed, report to the instructor. Do this during the working period.
(3) You should put away your work five minutes before the clean-up bell so that you will have enough time to take care of your duties.
(4) Excess cuttings from the machines should be brushed under the machines and out of the safety zones.
(5) You are responsible for brushing off and cleaning the jig-saw, bandsaw, tablesaw, and jointer. Also, the drill press, shaper, soldering bench, and sheet metal bench.
(6) At the end of the work period, see that the last students using the lathes clean them. Chips from the metal lathe should be placed in the keg.
(7) During the clean-up period, see that each student brushes off his bench and that all brushes are returned to their hooks. Students who were working in the foundry area are responsible for the clean-up there.
(8) Gather up scrap wood and blocks and place them in the scrap box. Scrap paper should be gathered up and placed in waste basket.
(9) Clean wash basins if dirty and see that all used paper towels are placed in the basket.
(10) See that aprons of officers are hung neatly and in order at the end of the hour. When shop is in order, report O.K. to the superintendent.

Many teachers find it expedient to designate in various ways the students holding positions. Probably one of the most common is that of having the name of the position embroidered on an apron or jacket which the student wears during the period of his service. Other methods include arm bands, large pins, or buttons. This item is important, especially in a large class, to assist the instructor in identifying the various officers and also to remind the student of his responsibility.

Assignment of Positions. In addition to the selection of positions and listing of duties, there should be some plan developed for assigning students to the various positions. This plan should be easily administered and result in each student having an equal chance to serve in all the positions.

There is a real temptation for the instructor, as he secures a smooth-running group, to hold these students on their assignments over a longer period of time. However, if one is to recognize the educational aspects and values of a student personnel organization, he will rotate these positions without regard to the ability of any given student.

Many devices have been developed by industrial arts teachers for assigning student positions. Probably the most common method used in the past has been the "rotating wheel," in which the positions and the student's name or number are placed on the circumference of two unequal-sized cardboard or wooden disks and then rotated according to a specified plan at regular intervals. A plan which seems to be more effective is the formal listing of the class officers or positions and the name of the student who holds the assignment. Mimeographed forms listing the positions with blank spaces for writing in the student's name could be used. There is a desirable psychological factor which must be considered as the student sees his name in connection with some responsibility.

Although the length of service will vary, depending on many conditions, about one week seems to be the usual and most common period. This amount of time allows for considerable efficiency of the plan but is not so long that younger students will lose interest.

Some method of breaking in the new officers is desirable. Most teachers feel that it is valuable for the student who just previously held the position to spend some time instructing

or assisting the student newly assigned to the position on the day the organization is rotated.

2. TOOLS AND EQUIPMENT

The arrangement and storage of tools bears a close relationship to the amount of checking required to make certain that everything is in its proper place and cared for. Many methods of checking and storage are used and all may have advantages according to their shop uses. Tools are commonly kept in (1) tool rooms, (2) on wall tool boards or open panels, (3) in wall tool cabinets, (4) in bench tool drawers, and (5) in racks on benches. Each system used should be worked out according to local conditions.

Some of the advantages and disadvantages derived from each method include:

(1) The toolroom provides an efficient way to keep tools in their proper place and reduces losses to a minimum. It is undesirable, however, in that it requires more traffic in the laboratory and some time is lost at the beginning and end of the hour. It usually requires the full time of a student to serve as the clerk of toolroom foreman which is not justified in smaller classes.

(2) The wall tool board or open panel is very convenient, and tools can be secured quickly without confusion to the class. With this arrangement, however, tools may be lost or stolen unless the shop room is kept locked when not in use.

(3) The wall tool cabinets or cases have an advantage over the open panel in that the case can be locked at the end of the class period, but when the classes are large, no record of checking is kept so that the loss may be greater than the tool room method. It takes up little space and is usually placed in the most convenient location.

(4) The bench tool drawers are very convenient for the worker, but more tools are required as each desk needs a set of tools. This system is usually difficult to check.

(5) The racks on benches also have the tools conveniently located and are easily checked, but many more tools are required than are used at one time.

Two other methods of storage are separate tool kits or portable tool cases. These may have only special uses in automechanics or machine tool work.

In determining the system to be used the teacher should consider these items: (1) number of students in the classes, (2) shape, size, and arrangement of the laboratory, (3) num-

ber of tools on hand and funds available to secure more, (4) number and kind of areas of work to be offered, and (5) uses the laboratory may have other than regular class teaching, such as hobby clubs and adult evening classes.

3. MATERIALS, SUPPLIES, AND BUDGET REQUIREMENTS

In checking supplies and materials, the quality, as well as the quantity of items on hand, are to be considered, and then compared with estimates of the amounts that are needed for the work planned for the next year. Record forms may be set up that note the particular kinds or brands of all supplies used and notations made on them from time to time that will be helpful in the future.

A knowledge of sources and prices of supplies and materials is valuable to students as well as teachers. Students may be taught to check supplies as they arrive to see if the correct amounts and kinds have been received.

In larger systems supplies are purchased by and through the business manager of the board of education, while in small schools, through the superintendent, principal, or secretary of the school board.

When ordering supplies and equipment the following information is usually necessary:

(1) Descriptive name.
(2) Catalog or serial number.
(3) Size, quality, and specifications.
(4) Quantity or amount.
(5) Unit and total cost.
(6) Name and address of company from which item can be purchased.

Supplies should be ordered in quantities large enough to last for at least a year. Local purchases should be made on materials and supplies when possible, or orders placed through local dealers.

A continuous record of equipment and supplies should be kept in every industrial arts department. This can become a time-consuming job if the system is not carefully organized and operated. A good plan of running or continuous inventories, however, can be a great aid to the instructor's work and will hold important information for the school administration as to the amount and condition of equipment. The instructor will find that most administrators are quite free with budget

requirements when they know that the materials purchased are carefully controlled. Such records will help to set up and justify future budget requirements. Students can gain valuable experience and information by assisting in the keeping of these records.

A budget for the industrial arts department may be set up with these divisions given consideration:

(1) Equipment.
This should cover a long period of planning. Machines and tools do not wear out rapidly, and consideration must be given to the fact that some day replacements and additional machines and tools must be purchased.

(2) Instructional Supplies
This will include those materials and supplies that are used for maintenance and instructional purposes and are not directly involved in the construction of articles that become the property of the student. It may include such items as oil, grease, glue, welding gas, sandpaper, finishes, and other materials that are needed for successful operation. Enough should be purchased at one time to last for a year.

(3) Project Materials (revolving fund)
The materials purchased with this fund should include those that are used and paid for by the students. Included in this list would be lumber, special hardware, metal stock, leather, craft materials, some finishing materials, and others. The money is revolved as the student pays for the material he uses. Many schools have an activity or similar fund that might be used for this purpose. Most items should be purchased in amounts large enough to last a year or more, thus effecting a saving in purchase prices and time in re-ordering.

4. OTHER RECORDS AND FORMS

A good record system is an important and necessary part of the organization of any industrial arts department. Schools will vary greatly in the pattern and plan followed in this matter. What the details of the plan consist of are not important. Of major concern is that some sort of system be in effect and used. In general, simplicity should be the keynote of the system so that maximum benefits may be gained with a minimum of time devoted to its operation.

The forms developed to expedite the record system used should be kept in a convenient location, usually in a cabinet located near the instructor's desk or in the planning and conference area. Some will be for the students' use and should

be made easily accessible to them. Others will be confidential and should be kept in a compartment which can be locked.

It is expected that the industrial arts teacher will keep a class-record book in the same manner as other teachers in the school. This usually is part of the administrative plan and should not be neglected. This record will include name and number of the course, year, period class meets, names of students, attendance records, excuses, final grades, etc.

These books are usually turned in at the close of the school year, and an effort should be made to keep their appearance respectable. It is generally expected that they will receive more abuse in the laboratory than in the so-called academic courses; however, some thought should be given to their general care. Some teachers who use this record a great deal have found that a coat of lacquer on the cover and class roll sheets will aid considerably.

A project record form of some kind is an important part of any industrial arts course. It should include some of the following information: student's name, name of project or problem, estimate of time, starting date, specifications, and check points. On this card, or attached to it, should also be a plan of procedure and a bill of materials. The suggested form shown in Figure 4 would be desirable for most industrial arts projects. Craft or beginning projects might be too small to justify such an extensive record.

PROJECT RECORD CARD

INDUSTRIAL ARTS HIGH SCHOOL

Name__________ No.______ Hr.______

Project__________ Class__________

Specifications__________

Plan O.K.______
Date Start______
F. R. O.K.______
Date Finish______
No. of Hrs.______
Com. O.K.______

O.K.	Q'TY	ITEM	SIZE	AMT.	COST

PRINT ALL INFORMATION NEATLY TOTAL COST

(card size 5½" x 8½")

FIGURE 4. PROJECT RECORD CARD

A *material record card* should be kept for each student, running through a term or semester. It would include such items as name, hour, course, year, name of projects, materials used, cost of materials, amount paid and balance due. The student should be expected to record some of this information. The cards should be filed alphabetically and kept in a convenient yet secure place.

Material Card

Hour	INDUSTRIAL ARTS DEPARTMENT Name________ Class________	Term	Locker	No.

Date	Projects—Material	Pupil's Sig.	Cost	Amt. Pd.	Remarks
	Total________				
	Refund				

Please Print All Information

(card size, 5" x 7")

FIGURE 5. MATERIAL RECORD CARD

Confidential data concerning individual students may be kept in a folder or on a form. Such information should be included as name, age, address, father's occupation, classification, courses taken in industrial arts, major interests, scores on standardized tests, and other material concerned with the personal, educational, and occupational adjustment of the student.

Hr._____ Class_____ Date_____ 19____

_____has my consent to operate the following power machines in the industrial arts laboratory of_____ High School, under supervision of the teacher in charge.

Please cross out the name of any machine you do not wish your child to operate.

Wood		Metal	
Jig Saw	Grinder	Lathe	Furnace
Lathe	Mortising Mach.	Drill Press	Forge
Bandsaw	Hand Router	Shaper	Arc Welder
Jointer	Shaper	Grinder	Gas Welder
Circular Saw	Surfacer	Milling Mach.	

_____

Parent or Guardian

FIGURE 6. MACHINE PERMIT

In many schools it has been the policy to have students submit written permission from their parents before being allowed to operate power machines in the industrial arts laboratory. Such a procedure seems highly justifiable. A form with the necessary statements and a list of the machines will expedite this matter. Such a form is illustrated in Figure 6.

Another form that is desirable in connection with safety is an accident report form such as the one shown in Figure 7. By making a formal report of all accidents at the time they occur more reliable and accurate data for ascertaining accident causes may be secured. This practice will help to keep the matter of safety uppermost in the minds of the students and instructor and will provide important information in regard to the school's liability in the accident. A copy of this report should usually be filed in the office of the principal or superintendent.

INDUSTRIAL ARTS DEPARTMENT

_____Public Schools

ACCIDENT REPORT

Name_____ Date_____ Time_____
Address_____ Age_____ Class_____ Machine or Tool_____
Shop experience_____
Had student been instructed in use of machine or tool with which the accident occurred?_____
Was student taking proper precaution?_____
_____
Was machine guarded?_____ Was student using guard?_____
Was student assigned to machine?_____
Job being done when accident happened?_____
Extent of accident?_____
_____
Teacher's opinion of cause of accident_____
_____
Witness_____ Address_____ Phone_____
Attending Physician_____ Address_____ Phone_____
Instructor_____

(card size 4" x 6")

FIGURE 7. ACCIDENT REPORT

5. SAFETY

The industrial arts laboratory, because of the nature of the work and equipment, is more hazardous than other curriculum areas. This implies that the industrial arts instructor has a very real opportunity as well as a responsibility in regard to safety education.

Merely listing safety rules, displaying posters and signs, and warning students of the hazards, does not constitute an adequate program. A planned program of safety education integrated with the total industrial arts program will more nearly insure the development of a desirable safety concept. Many instructors tend to evaluate their safety program only in terms of the number or kinds of accidents that occur in their laboratory. This is important; however, a broader point of view should be developed. The instruction and experience in the industrial arts classes should result in a knowledge and attitude that can be applied successfully to a great number of life situations extending far beyond the class room.

"Hazards in the school shop should be thought of as three-fold. There are hazards to the worker, hazards to the tool or the machine being used, and hazards to the materials being

fabricated. Perhaps too many teachers emphasize the former hazard almost to the exclusion of the other two. In doing so they lose splendid opportunities to round out a comprehensive view of the problem. It is hardly possible to build up a complete, usable, understandable practice of safety unless we include both the practice that will be best for the operator, and encourage the habit of looking for potential dangers to the things with which the operator works."[1]

The most effective way to teach safety is to provide the student with an opportunity to practice safety after complete instructions and thorough demonstrations have been given. This can be supplemented with posters, visual aids, rules, and other devices.

In the development of a plan for teaching safety the instructor must consider the causes of accidents, classify and study them, and devise ways and means of eliminating or controlling them. Some of the more common causes of accidents in the industrial arts laboratory would include the following:

Physical Conditions

(1) Lack of adequate guards and other safety devices on machines.
(2) Equipment in a poor state of repair.
(3) Inadequate natural and artificial light.
(4) Machines poorly arranged and no safety zones provided.
(5) Damaged hand tools, files without handles, etc.
(6) Inadequate provisions for storage of projects, materials, and supplies.
(7) Inadequate provision for shavings, waste and scrap.
(8) Working poor or defective material.
(9) Lack of adequate ventilation in hot metal areas and finishing rooms.
(10) Unsatisfactory or damaged floors.

Instruction and Management

(1) Instructor's inadequate knowledge of tools and machines.
(2) Students operating machines without sufficient instructions.
(3) Lack of supervision in regular classes and over-time periods.
(4) Physical defects of the student.
(5) Students playing with machines and equipment.
(6) Improper attitude of the student.
(7) Students operating machines without permission.
(8) Attention distracted while operating machines.
(9) Over-crowded classes.

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[1]Noel B. Grinstead, "Building a Safety Concept," *Industrial Arts and Vocational Education*, January 1937, page 12.

After a study of the causes of accidents is made the instructor must plan for the elimination of as many undesirable factors as possible and adjust and control those which cannot be entirely eliminated. Some of the desirable actions would include the following:

(1) Establish definite policies and regulations regarding the safe use of all tools and equipment.
(2) Give carefully organized and complete instructions, including safety factors, for all equipment.
(3) Follow up instruction with additional help and supervision.
(4) Make all necessary improvements in the building, machinery, equipment, lighting, and ventilating.
(5) Repair or discard unsafe equipment.
(6) Provide safeguards for hazards that can not be eliminated.
(7) Provide proper personal protective equipment, such as goggles, respirators, gloves, etc., and insist upon their use.
(8) Organize and provide for proper housekeeping and maintenance.
(9) Make use of safety literature, bulletin boards, posters, and other visual aids.
(10) Prohibit conversation between machine operator and other students.
(11) Establish a "safety engineer" or other student assistants to help control safety problems.
(12) Develop an attitude (a safety concept) that will function both in and out of the laboratory.

Safety rules for each machine should be listed, taught, and posted near the machine so that each student will know how to operate it properly. Each machine will require a separate list of rules. The following is an example of safety rules for the operation of the jointer:

(1) Make only the adjustments for thickness of cut and position of the fence.
(2) Do not adjust the rear table or remove the guards without the instructor's permission.
(3) The maximum cut for jointing an edge is ⅛ inch and for a surface 1/16 inch. Heavier cuts can be made if permission is secured from the instructor.
(4) Have all special set-ups, for example, those involved in cutting rabbets and tapers, checked by the instructor before the machine is turned on.
(5) Keep the hands away from the cutter head and do not allow them to pass directly over it.
(6) Permission must be received from the instructor for jointing end grain.
(7) Stock must be at least 10 inches long. Observe other stock size limitations explained by the instructor.

(8) Be careful of the clothing you wear. Loose clothing may wrap around the cutter head. Tuck in your necktie and roll up loose fitting sleeves.
(9) Never start the cut until machine is running at full speed.
(10) Do not start the machine until the following requirements have been met:

a. You understand what is to be done to the wood.
b. The jointer is adjusted for proper thickness of cut.
c. The fence is correctly set and firmly locked.
d. The front and rear guards are in place.
e. The tables are free of tools and stock.
f. If a push block is necessary, the proper one is selected.
g. The floor is clear of shavings and scrap wood.
h. A helper is provided for handling long pieces, and understands what he is to do.
i. The stock is not too small, short, or long to be handled safely.
j. The direction of the grain is determined and marked on the wood, and the stock is arranged so that the knives will not cut against the grain.[2]

It is not sufficient to post the rules near the machine involved. They must be demonstrated and explained by the instructor. The student must understand the "why" for each rule. This will provide him with an understanding that will enable him to make correct decisions for situations where no rule applies.

The industrial arts instructor must be ever mindful of the fact that he sets to a large extent the standard in regard to safety attitude and practice. He should check carefully the validity of the rules and regulations he sets forth and then adhere to them with as much care as he expects from his students.

First Aid—"Industrial arts instructors should have more than a superficial knowledge of first aid principles and practices. They are called upon frequently to administer first aid to students inside and outside of the shop, and it is to be expected that they will know what they are doing. There are numerous simple textbooks for the teachers who do not feel adequately prepared in this phase of teaching. The American Red Cross and several life insurance companies will be able to supply teachers with copies of first aid manuals. Many teacher-training institutions now offer classes in first aid and safety

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[2]Silvius and Baysinger, *Safe Work Practice in Woodworking*, American Technical Society, 1946, page 51.

education that should be included in the program for industrial arts teachers."[3]

When considering first aid in the shop the following points should be remembered:

(1) A first aid kit should be placed in a convenient place in every shop.
(2) The first aid kit should be sufficiently stocked at all times, and it is a duty of the administrator to make sure that such is the case.
(3) Each kit should have a set of simple directions for the administering of first aid.
(4) Proper attention should be given to even the smallest cuts or wounds. Without proper care they are apt to be very serious.
(5) First aid, as the name implies, is the primary attention given to a cut, wound, or accident. It is to be doubted if the teacher should continue to treat a student after the first attention. Such cases should logically be treated by the school nurse or a physician.

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[3]*Utah Industrial Arts Handbook*, State Department of Education, Salt Lake City, 1941, page 160.

Chapter IV

TEACHING METHODS AND PROCEDURES

Methods in industrial arts teaching are built around the "project method" concept. This is not an exclusive feature of this area of the curriculum, but it is continually being given more emphasis by leaders of education in other curriculum areas.

The project in industrial arts laboratories is not defined as just some articles made by the student. It becomes a project only when it provides for student participation in proposing, planning, constructing, and evaluating. The use of tools and materials in accordance with detailed directions may result in the production of an article often called a project. This result, however, may be far from what is referred to as the project method. Learning through following a ready-made job plan that contains a solution of all of the evident problems does not encourage or in many cases even permit the student to do any reasoning of his own.

The project method in industrial arts centers around work activities. However, the industrial arts teacher must realize that the project can include appreciational learning and other educational values as well as motor skills or technical knowledge. To study power, communication, and transportation in such a way that the student will become familiar with the world in which he lives is the important outcome of the project method of teaching.

1. SELECTING PROJECTS

There is considerable variance in actual practices as to procedures used in selecting projects. These practices range all the way from a required list to be completed in a given order, all of which is prescribed by the instructor, to complete freedom on the part of the student in regard to the selection. The first method usually results unsatisfactorily in any family having three or four boys in school making three or four footstools all of the same design and detail. The other extreme usually produces a low quality of finished product and quite often complete failure.

The correct answer lies somewhere between these two extremes. It should favor pupil proposing and planning under the guidance of the instructor. It is possible to secure most of the value from the project when the instructor through skillful suggestion stimulates in the minds of the students their first desires and interests. This procedure is highly justified in beginning classes and with students who are taking their first courses in industrial arts. Projects should be thought of as student-teacher selected. The degree of teacher participation will vary inversely with the experience and background of the student.

Several generations ago it might have been possible for industrial arts teachers to set up a required list of articles from which the students could select. The required articles could have still filled the need of most of the students because their background and experience would have been quite comparable. There was not the opportunity for boys and girls to develop a great deal of difference in these matters. In any given community they would have about the same chance to observe and participate in the common every day tasks. Today the scene is different. Many opportunities exist for boys and girls to observe or even participate in a great variety of activities. These opportunities may be the outgrowth of community industries, hobby clubs, home workshops, etc. The complicated social and economic order in which we find ourselves permits less and less homogeneous grouping of our students.

With student-teacher selected projects it is important that the teacher be aware of the problems involved, so that he may be able to make valuable and practical suggestions to the student. In some cases he may wish to set up a range of limitations and should have some criteria on which to base these decisions. The following are some of the factors that should be considered in project selection. Students should also be aware of and have some understanding of these items:

(1) The student should have real interest in the project. In most cases this project will develop around his play and recreational activities or his avocational and vocational interests. It is the instructor's responsibility to discover and strengthen desirable interests that will result in worthwhile activities.
(2) They should challenge the student's ability. Individual differences in interest, capacity, and perseverance must be recognized.

Projects should not be too simple or easy. Neither should they be too long and difficult. Students are often inclined to overestimate their ability, and because of their inexperience are unable to foresee the difficulties that may arise.

(3) The project should be within the range of the physical set-up. Such questions as these should be answered. Are the necessary tools and machines available? Can all of the materials be secured? Are costs within range of the student's ability to pay?

(4) The project should include some of the processes and information included in the content of the courses. It should supplement and extend the student's experiences both in and outside of class.

(5) The projects should always have some evident and significant value for the individuals or groups that undertake them. The students will naturally consider the utilitarian aspects, but the instructor should be aware of the values of appreciation, analysis, and reflective thinking that are involved.

(6) They should be of such a nature that they can be completed within a reasonable time equal to an interest span of the student. This time will vary from a few weeks in the elementary and junior high school to as much as an entire semester in the senior high school.

2. PLANNING PROJECTS

After the student has selected a project he should develop carefully made plan. The planning of the project should lways precede the execution of it; otherwise the student may e working in advance of his thinking, which may result in ıany unnecessary problems and difficulties. The time spent ı thinking through and planning details of the work will preent waste of materials, save time and energy, insure a better nished article, and help develop systematic habits of work or the student.

In beginning classes this planning must necessarily be closely ıpervised and done under much teacher guidance, while in dvanced classes students may be able to develop complete lans for their projects. Planning ability will be developed by eaching pupils to do their own thinking and guiding them in ıch a way that they will assume the responsibility of seeing ıe project through to completion. Group, as well as individual lanning, should be considered, as it provides an opportunity or students to develop the ability to cooperate with others.

Planning may include some or all of the following phases:

(1) Developing the design, specifications, and details of construction. This will include freehand sketching, instrument drawing, study, and research.

(2) Listing, step by step, the most efficient procedure for carrying out the work.
(3) Listing the material and supplies needed for the project. This listing may include amounts, qualities, specific use, and estimated costs.
(4) Listing tools, processes, and information.
(5) Time and motion study. This refers to estimating the amount of time required, budgeting this time, determining probable starting and finishing dates, and planning for the availability of equipment and materials as needed.

There will be times when it is not possible to anticipate all of the problems or steps necessary for the completion of the project, and in such cases the work may become somewhat experimental in nature. Nevertheless, most of the procedures and problems will be evident and formally planned.

Designing Projects. One of the important and very difficult objectives of the industrial arts program is the development of appreciation and good taste in the design of projects. This objective, if properly developed, will provide the student with a knowledge that will be helpful to him in the selection of commercial products in adult life.

Many industrial arts instructors have not recognized or given sufficient emphasis to this problem. They have permitted many poorly designed pieces to be developed in their program, and these have been ridiculed by those who know good design and construction.

Instructors who feel they are not well trained in the principles of art as applied to construction problems typical of industrial arts may do well to limit to some extent their experiments in design. This does not mean that they should not give considerable thought and effort to the development of their ability along this line. Just being creative is of little value unless something worthwhile and acceptable is developed. Objects developed without consideration of accepted elements of good design usually have only a temporary appeal and are soon discarded.

There are at least three elements that good designers consider:

(1) Utility. Structural considerations start with the use or function for which the object is to be made. Utilitarian objects, if well designed for their intended purposes, may have real appearance value. The answer to these questions will aid in this problem: What is its use? How is it used? Where is it used?

(2) Construction. This will vary with the material being used. There are usually a number of choices here. The method and type of construction must match the material selected. No amount of ornamentation or decoration can hide or excuse the use of inferior materials or poor construction.
(3) Enrichment. Beyond the fact that an article performs its functions and is well made of suitable materials, there is the possibility of including the appeal to the senses that may result in beauty. This is not something added, but should be considered throughout the development of the design. The industrial arts instructor should know and be able to apply the principles of proportion, balance, rhythm, and harmony.

3. WRITTEN INSTRUCTION

Written instruction constitutes a very valuable teaching device, but it is not intended to supersede all the other forms of instruction. It must be well prepared, and the work must be organized and planned so as to make provision for its use. When the instructions are well written and the work properly organized they have the following advantages:

(1) They are more brief and accurate than oral instruction.
(2) The material can be selected with care in order to make clear the main points.
(3) They are in permanent form.
(4) The responsibility is placed upon the student.
(5) They must help develop a feeling of responsibility and self reliance.
(6) They are less expensive than oral instructions.
(7) They give ample time for the instructor to give individual oral instructions when such instructions are needed.
(8) The instructions can be examined and arranged for the most effective learning.

There is a wide selection of instructional materials now available in handbook form. Most industrial arts instructors depend on these for their written instructions. There is usually a need for some that apply directly to the local situation. These must, of course, be prepared by the instructor.

4. DEMONSTRATIONS AND ORAL INSTRUCTION

The purpose of the demonstration is to show how things are done. When properly planned and conducted, it is one of the most effective teaching devices. Many factors are involved in giving a demonstration, such as the pupil's interest, proper

attitudes, physical condition of classroom, and need for the instruction. A well-timed and skillfully executed demonstration has a very good effect upon the class. It eliminates the element of doubt in the minds of the students as to whether or not the process or operation can be performed and also provides a standard for their work.

The following principles should be observed when giving individual or group demonstrations:

(1) A clear and definite statement of the objective must be made.
(2) The demonstrations should be given as the need arises.
(3) All preparations should be carefully made in advance.
(4) The instructor should follow up and check the effectiveness of the demonstration.
(5) The demonstration should be brief.
(6) If written instruction sheets are used, the teacher should follow the operations as given in the printed material.
(7) The skill of the teacher should be an ideal to be followed.
(8) Correlated or unrelated materials should not be brought into the demonstration of a skilled process.
(9) One fundamental process should be shown at a given time.
(10) The demonstration should conform to the ability and experience level of the students.

Individual oral instruction may provide for individual needs, but it is more wasteful of time and energy than group instruction. It is very difficult for a teacher to meet all the needs of the entire class through individual instruction. Oral instruction, despite its limitation, has always been and still is one of the chief teaching devices. Students usually prefer this kind of teaching if it is combined with demonstration. It requires less energy and attention on the part of the student, but more activity on the part of the instructor.

5. STARTING A CLASS

The first days of the school year are the most important and difficult for the industrial arts instructor. They require careful planning and preparation. The impression made during the first few days may determine to a large extent the attitude that will be adopted by the students.

It is of utmost importance that the students be permitted to "get to work" as soon as possible. Their general conception of the industrial arts laboratory is that it is a place to do things. Long lectures, involving information and procedures not essen-

tial to the first few days, will disappoint students and dull their interest. This does not mean, however, that students be permitted to start their work until they understand the important, basic, and beginning procedures and instructions.

The plans for the first days will vary greatly, depending on some of the following factors:

(1) Level of the work.
(2) Age and background of the student.
(3) Areas of activities (number and kind).
(4) Size, arrangement, and condition of the laboratory.
(5) Length of class periods.

Industrial arts instructors have devised many ways of starting beginning classes in laboratories where a number of areas of activity are represented. Some of the more common methods are as follows:

(1) The instructor demonstrates to the entire group the first processes and operation in each of the areas. Plans are developed or distributed for the initial projects. Information in regard to the general rules, procedures, and organizations are given. The students are then assigned to various areas and go to work. This plan seems to be desirable. However, it has the disadvantage of presenting demonstrations that the students may not be able to put into practice for several weeks or months. It also requires considerable time.
(2) The above plan can be varied by substituting instruction sheets for the demonstrations. The students are assigned problems or projects in specified areas. The instruction sheets are studied by the student, and as soon as he has filled out necessary forms, made sketches, and answered questions, he is ready to work.
(3) In situations where classes are small it is quite possible for students to select to some extent their projects and areas of work. The time needed by the students to develop their plans will vary, thus making it possible for the instructor to give initial instruction and demonstration on an individual basis.
(4) Some teachers find it desirable to start all students in the same activity. This, of course, requires considerable extra equipment. Usually the area selected is drawing. With a definite amount of work planned, the individual differences will cause the students to finish at different times. As each student finishes drawing, he may select another field. The instructor is able to give individual or small group demonstrations in the various areas.
(5) In some schools it is necessary to enroll advanced and beginning students in the same class. This practice has many disadvantages, but it does provide the instructor with another means of starting beginning students. These advanced students can give

some of the beginning demonstrations in the various areas, until the instructor can take over his functions for the whole class. If such a plan is used it is advisable to give these leaders definite instruction about their duties in advance.

(6) A plan, not highly recommended, is that of starting only a part of the class while the rest report to the study hall or reading room under the direction of another teacher. Each day an additional group is brought into the laboratory, until the entire class is started.

There are many combinations and variations of the above plans. Each instructor will need to devise his own, depending on many limiting factors in his own situation. The important thing is that study be given to this matter and the best possible procedure be developed.

6. AUDIO-VISUAL AIDS

Although, in most learning, the sense of vision plays a somewhat larger part than do the other forms of sense-perception, it is well to recognize the interrelationships and coordination that rightly exist among the senses. The following is a list of learning aids:[1]

(1) Aids through the eye (Visual)
   a. Projectors: Glass slide, film slide, opaque, micro, motion picture, and stereoscope.
   b. Camera: Kodak, miniature, motion picture.
   c. The reproducing devices: The hectograph (gelatin), the mimeograph (stencil, hand and rotary), and the multigraph (metal type).
   d. The blackboard.
   e. Slide-making apparatus.
   f. Lenses, microscope, telescope.
   g. Pictorial materials.
   h. Representations, maps, diagrams, etc.

(2) Aids through the ear (Auditory)
   a. The phonograph.
   b. The radio.

(3) Aids through the eye and ear (Visual-Auditory)
   a. Sound motion picture.
   b. Radio vision.
   c. Television.

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[1]F. Theodore Struck, *Creative Teaching*, New York, John Wiley and Sons, 1945, Chapter X, "Visual-Sensory Aids to Instruction."

(4) Aids through activity
   a. The school journey or field trip (including the class period trip, the half-day or full-day trip, and the vacation trip).
   b. The miniature set (student made), the sand table or table top, and marionettes or puppets.
   c. The object—specimen—model collection.
(5) Miscellaneous
   a. Dramatization.
   b. Pageantry.
   c. Booklets.
   d. Exhibits.

Motion pictures are the chief, and perhaps the most recently developed, visual aids. They are available in silent, sound, color, and black and white, also in 16 and 35 mm. sizes.

Just to order a few films and have a "picture show" does not signify that students are receiving the desired values from the films. The following suggestions for using films for educational purposes may assist in obtaining the results desired:

(1) The instructor should familiarize himself with the content of the film through previews and through catalog descriptions.
(2) The film should be shown at the proper time to receive the most benefit. It should be timed to correspond with material taught in the classroom.
(3) After the film has been selected and analyzed the next step is to motivate the students and assist them in receiving the maximum results. This may be done by preparing outlines or questions covering the material to be presented.
(4) The method of presenting the film is important. It may be desirable to discuss the film after the first showing and then show it again either partially or in full.
(5) The final checking upon the students to determine the value received is an essential feature not to be omitted. This may be done either orally or in writing, and will help to correct any wrong impressions that have been received by the students.

The four general sources of films available for school use are:

(1) Rental of selected films.
(2) Purchase of film for the school library.
(3) Local production.
(4) Free films contributed by industry.

For a list of film sources the reader is referred to the appendix.

Many posters and charts are available. These may be used to illustrate various kinds of tools and machines, showing their construction and how they are used. Lantern slides and film strips are other helpful visual aids.

7. FIELD TRIPS

One of the objectives of industrial arts is to provide an opportunity for students to develop an appreciation for and an understanding of the values of the industrial products of the world in which they live.

It is almost impossible to duplicate industrial conditions in the school, so in order to attain this objective it is necessary for the instructor to take the class into the industrial plants of the community, where they can see for themselves how the work is done and what is expected of labor.

In every community, large or small, there are places of interest to which the students may profitably make trips. The following list will suggest some places to visit:

(1) Art and architecture: galleries, exhibits, churches, homes, public works, landscaping.
(2) Communication: telephone and telegraph offices, exchanges, lines, plants, radio broadcasting stations and studios.
(3) Engineering: bridges, highways, tunnels, viaducts, canals, buildings, power plants, drainage and sewage systems, flood and erosion controls.
(4) Factories: automobiles, airplanes, clothing, ceramics, tools, implements, furniture, machinery, glass, canning, cement, tile.
(5) Mines and quarries: coal, zinc, lead, stone, gravel, granite, clay.
(6) Oil: wells, refining and processing plants, pumping stations, pipe lines, tank cars, filling stations.
(7) Shops: machine, blacksmith, plumbing, carpenter, printing.
(8) Trade schools and colleges.
(9) Transportation: land—railway, elevated and subway lines, bus lines, trucking corporations, repair shops, freight and express services, automobile and trailers; water—boats, ferry, docks, canals, locks, bridges, airports, hangars, airplanes.
(10) Utilities (municipal and private): water, heat, power, light, gas.

In order that the field trips will be educationally worthwhile, they must be planned with much care, and the class should feel that it is a part of their regular class work and not a holiday.

To be most effective such visits must be planned far in advance. Simply to telephone for permission to take students through is not sufficient. The teacher should first visit the plant personally and note for himself the work being done in order that he may decide what will be the most valuable for students to see. He may use this information to develop an outline which will guide the students in securing information about the industry or plant.

The following may serve as an example of the information that might be gathered by the industrial arts class during a field trip:

(1) History of the plant.
(2) Products made.
    a. Main products.
    b. By-products.
(3) Workers.
    a. Range of wages.
    b. Number of men.
    c. Number women.
    d. Length of working day and week.
    e. Personal qualifications.
    f. Experiences required.
(4) Working conditions.
    a. Labor organizations.
    b. Lighting, heating, and ventilation.
    c. Hazards, dangers, accidents, and safety precautions.
    d. Opportunity for advancement.
(5) Machinery, equipment, and power.
(6) Distribution of products.
    a. Storage.
    b. Transportation of materials.
    c. To whom sold.
    d. Annual value of output.

The trip should be supervised most carefully in order to protect both the school and the students. The group on a field trip represents the school to the community, and consequently any boisterousness, carelessness, accidents, or other unpleasantness will immediately cause bad publicity and an unfavorable reaction toward the school. These undesirable possibilities can be prevented by carefully preparing the students for the trip and closely supervising them while it is in progress. If the class is large it can be divided into small groups with a guide for each group. More students will then be able to ask questions and hear the guide's descriptions.

Chapter V

AREAS OF ACTIVITIES

The purpose of the material presented in this chapter is to describe some of the various areas of activity in the industrial arts program. Each area is described by listing in outline form processes, operations, information, and suggested problems or projects involved in the activity.

An attempt has been made to make this listing rather comprehensive. It is not expected that any one student could possibly cover all of the content listed. However, beginning students should have an opportunity to master some of the basic and fundamental processes and information in each area. Advanced students concentrating in one area might well be expected to complete and even extend the material outlined in that particular area.

Suggested projects are listed in connection with most of the areas. This does not mean that every project should be planned to include work in only one area. It is highly desirable for them to involve activities in several areas. For example, a wheelbarrow could require planning and drawing, wood work, and metal work.

There are other very desirable areas of industrial arts, such as printing, photography, and other crafts that are not described in this section. It is hoped that as this material is revised these and other areas may be given consideration.

In any given situation, those responsible for developing the industrial arts program may find this listing helpful as they plan the content of their courses.

1. PLANNING AND DRAWING

Drawing is a universal means of expression. Much of our present knowledge depends upon drawing, whether it concerns the history of early civilization or the development of the most modern engineering projects. The ability to describe the shape and size of objects through drawing and to understand blueprints and drawings made by others is highly desirable for any one, regardless of his particular vocation.

Student planning requires many of the skills and considerable of the information gained in drawing. These activities are therefore listed together.

Beginning work in drawing should be general in nature and include free-hand sketching, visualization, problem solving, and some instrument work. To have the student draw some of the projects that he might make in other areas of work is desirable.

PROCESSES AND OPERATIONS

I. Planning a project
   1. Selection
   2. Sketching and study
   3. Listing materials
      a. Kind
      b. Size
      c. Cost
   4. Study and list steps
   5. Study process and information involved
   6. Determine inspection points
   7. Time and motion study

II. Making a freehand sketch
   1. Straight lines
   2. Curves and circles
   3. Blocking in
   4. Brightening
   5. Size description
   6. Orthographic views
   7. Pictorial views
   8. Working drawings

III. Using instruments
   1. Drawing board
   2. T-square
   3. Scale
   4. Triangles
   5. French curves
   6. Pencils and pens
   7. Erasers and shields
   8. Compasses
   9. Dividers

IV. Making a working drawing
   1. Visualizing and sketching
   2. Attaching paper to board
   3. Laying out border and title bloc
   4. Spacing views
   5. Blocking in
   6. Geometric construction
   7. Conventional practices
   8. Dimensioning views
   9. Brightening
      a. Visible and invisible outline
      b. Center lines
      c. Dimensions
   10. Lettering
   11. Bill of material
   12. Checking
   13. Title

V. Drawing orthographic views
   1. Visualizing
   2. Selecting views
   3. Using line symbols
   4. Order of drawing lines

VI. Drawing auxiliary views
   1. Auxiliary elevations
   2. Right and left auxiliary views
   3. Front and rear auxiliary views
   4. Oblique views

VII. Drawing sectional views
   1. Full section
   2. Half section
   3. Broken out section
   4. Revolved section

PROCESSES AND OPERATIONS (Cont.)
- 5. Others
- 6. Cross hatching
- 7. Conventional symbols for materials

VIII. Dimensioning drawings
- 1. Selecting and placing dimensions
- 2. Drawing lines and symbols
  - a. Dimension lines
  - b. Extension lines
  - c. Leaders
  - d. Arrows
  - e. Numbers and notes

IX. Making wood working drawings
- 1. Details
  - a. Joints
  - b. Fasteners
- 2. Assemblies
- 3. Specifications and notes

X. Making machine drawings
- 1. Standard symbols
- 2. Conventional representations
- 3. Fasteners, gears, cams
- 4. Detail and assembly drawings

XI. Making sheet metal drawings
- 1. Developments
  - a. Prisms
  - b. Cylinders
  - c. Pyramids
  - d. Cones
  - e. Combination pieces
  - f. Transition pieces
- 2. Intersections
  - a. Prisms
  - b. Cylinders
  - c. Cones and pyramids
  - d. Combinations

XII. Drawing pictorial views
- 1. Isometric
- 2. Oblique
- 3. Cabinet
- 4. Perspective
  - a. Parallel
  - b. Angular
- 5. Others

XIII. Making architectural drawing
- 1. Floor plans
- 2. Elevations
- 3. Presentation drawings
- 4. Sections
- 5. Details
- 6. Symbols
- 7. Line technique and lettering

XIV. Making aircraft drawing
- 1. Detail
- 2. Assembly
- 3. Master diagram
- 4. Layout drawings
- 5. Standard parts
- 6. Conventions
- 7. Jigs and fixtures
- 8. Checking

XV. Making electrical drawings
- 1. Electrical symbols
- 2. Wiring diagrams
- 3. Schematic drawings

XVI. Making welding drawings
- 1. Form symbols
- 2. Fusion symbols

XVII. Making pipe drawings
- 1. Threads
- 2. Fittings
- 3. Valves
- 4. Symbols
- 5. Piping layouts

PROCESSES AND OPERATIONS (Cont.)

XVIII. Making graphs, charts, and maps
1. Rectilinear chart
2. Polar charts
3. Route charts
4. Flow sheets
5. Bar graph
6. Pie chart
7. General display
8. Plates
9. Topographic
10. Contours
11. Map symbols
12. Profile maps

XIX. Tracing and duplications
1. Pencil tracing
2. Ink tracing
3. Blueprinting
4. Black and white printing
5. Other reproduction methods

INFORMATION

I. Equipment and materials (drawing boards, T-squares, pencils, instruments, paper, etc.)
1. Manufacture
2. Selection and care
3. Trade names
4. Costs
5. Grades

II. Importance of drawing in industry and life situations —Application

III. Lettering
1. Kinds and styles
2. Composition
3. Methods
4. Titles

IV. Orthographic projection
1. Theory
2. Planes of projection
3. Principles
4. Auxiliary views
   a. Definition
   b. Reason for their use
5. Section views
   a. Principles
   b. Reasons for use
   c. Types of sections
   d. Special uses
6. Dimensions
   a. Principles
   b. Theory of dimensioning
   c. Rules for dimensioning
   d. Allowances and tolerances
   e. Classification of fits
   f. Finish mark and notes

V. Machine drawing
1. Machine parts and terms
2. Inventions and engineering
3. A.S.A. standards
4. Mechanical fasteners
5. Conventional representations

VI. Pictorial drawing
1. Advantages and disadvantages
2. Examples
3. Suggested use

VII. Architectural drawing and home planning
1. Building materials
2. Styles of domestic architecture

PROCESSES AND OPERATIONS (Cont.)

3. Factors to consider in selecting the site
4. Fundamental considerations in planning floor space
5. Source of aids for the home builder
6. Types of framing

VIII. Sheet metal drawing

1. The sheet metal industry and its products
2. How patterns are made in the shop
3. Allowances for joints, seams, bends, etc.

IX. Aircraft drawing

1. Types and examples
2. How they vary from other drawings
3. Master line layout (lofting)
4. Zoning
5. Free faired lines
6. Dash numbers
7. Special conventions

X. Special drawings

1. Patent-office
2. Welding
3. Electrical
4. Shading, tinting, rendering, etc.

XI. Special equipment

1. Pantograph
2. Production printing equipment
3. Mechanical lettering devices
4. Scales, templates, and splines
5. Drafting machines
6. Planimeter

XII. Reproduction processes

1. Blueprinting
2. B & W
3. Ozalid
4. Van Dykes
5. Photostat
6. Mimeograph
7. Ditto machine

XIII. Occupational opportunities and requirements for the draftsman

XIV. Elementary principles of design as applied to structure, contour, and surface enrichment

SUGGESTED PROBLEMS AND PROJECTS

I. Freehand sketching

1. Sketches of projects in all areas
2. Visualization practice
   a. Orthographic
   b. Pictorial
3. Diagrams, layouts, patterns
4. Developing designs
5. Sketches of problems to be drawn with instruments

II. Instrumental drawings

1. Principal view drawings
2. Drawings involving auxiliary views
3. Drawings involving sections
4. Working drawings
5. Drawings of sheet metal problems
6. Drawings of woodworking articles
   a. Details

SUGGESTED PROBLEMS AND PROJECTS (Cont.)

b. Assemblies
7. Drawings of machines
   a. Details
   b. Assemblies
8. Drawings of electrical parts, circuits and hook-ups
9. Drawings of house plans
   a. Plot
   b. Floor plans
   c. Elevations and sections
   d. Details
10. Drawings of simple airplane parts
11. Special drawings

III. Designing and drawing either freehand or with instruments
   1. Safety posters
   2. Wall charts
   3. Graphs
   4. Maps
   5. Patterns

IV. Drawings for reproduction
   1. Pencil tracing of any drawings
   2. Ink tracing of any drawings

V. Blueprinting and other methods of duplication

2. WOODS

Wood is the most common material used in our industrial arts laboratories in Iowa. It has been stressed because wood is easily formed and worked, is relatively inexpensive and easily obtainable. Wood is used extensively in building construction, furniture making, and abounds in hobby possibilities. It can be expected to continue as an important material in our industrial arts programs.

PROCESSES AND OPERATIONS

I. Planning and laying out
   1. Reading a working drawing
   2. Making a working drawing sketch
   3. Making a bill of materials
   4. Estimating costs
   5. Marking with a knife, square, and pencil
   6. Measuring with a rule
   7. Gauging with a marking gauge, pencil gauge and mortise gauge
   8. Drawing arcs and circles with dividers, compass or trammel points
   9. Drawing an ellipse and polygons
   10. Making templates
   11. Laying out angles from a framing square
   12. Laying out duplicate parts

II. Sawing
   1. Crosscutting
   2. Ripping
   3. Making cuts with the backsaw
   4. Cutting curves with coping saw, turning saw or compass saw
   5. Cutting angles in the miter box

PROCESSES AND OPERATIONS (Cont.)

III. Hand planing
1. Adjusting the plane
2. Planing a surface
3. Planing an edge
4. Jointing two edges for gluing
5. Planing bevels, chamfers, and tapers
6. Planing end grain
7. Planing with router and rabbet plane
8. Smoothing with scrapers

IV. Shaping
1. Smoothing curves with wood file
2. Smoothing curves with spokeshave
3. Smoothing curves with sandpaper

V. Chiseling
1. Chiseling with the grain
2. Chiseling across the grain
3. Vertical chiseling
4. Cutting with a gouge
5. Cutting with carving tools

VI. Boring
1. Boring with auger bit
2. Boring with a forstner bit
3. Boring with an expansive bit
4. Boring with square shank twist and gimlet bits
5. Boring with hand drill and straight shank bits
6. Stop boring
7. Countersinking and counterboring

VII. Sharpening tools
1. Grinding, whetting and filing
   a. Chisels and plane irons
   b. Scrapers
   c. Saws
   d. Bits
   e. Screwdrivers
   f. Gouges
   g. Knives

VIII. Joinery
1. Laying out and cutting
   a. Rabbets
   b. Dadoes
   c. Grooves
   d. Laps
   e. Dowel joints
   f. Miter
   g. Mortise and tenon
   h. Tongue and groove

IX. Gluing and assembling
1. Clamping and trial assembly
2. Preparing glue
3. Gluing edge joints
4. Gluing rectangular structures
5. Glueing frame and panel
6. Gluing miters, segments, and irregular shapes

X. Using wood fastenings
1. Nails
2. Screws
3. Corrugated fasteners
4. Bolts
5. Cabinet hardware
6. Miscellaneous hardware

XI. Wood finishing
1. Sanding and preparing surface
2. Applying stains

PROCESSES AND OPERATIONS (Cont.)

3. Applying fillers and sealers
4. Applying shellac
5. Applying lacquer
6. Applying varnish
7. Applying paints and enamels
8. Rubbing down finishes

XII. Upholstering

1. Simple padding
2. Applying webbing
3. Rolling an edge
4. Mounting and tying springs

XIII. Using the jointer

1. Adjusting the table and fence
2. Adjusting and using guards
3. Jointing an edge
4. Surfacing stock
5. Squaring stock to dimensions
6. Tapering
7. Rabbeting
8. Beveling and chamfering

XIV. Using the table saw

1. Adjusting machine and changing blades
2. Adjusting and using guards
3. Ripping
4. Cutting stock to length
5. Re-sawing
6. Beveling and chamfering
7. Tapering
8. Rabbeting
9. Mitering
10. Cutting dados and grooves
11. Cutting tenons
12. Sharpening blades

XV. Using the band saw

1. Adjusting the machine and changing blades
2. Cutting curves
3. Ripping, beveling, and tapering
4. Crosscutting
5. Sawing disks and segments
6. Multiple sawing
7. Sawing with patterns
8. Sharpening blades
9. Brazing blades

XVI. Using the jig saw

1. Adjusting machine and fitting blades
2. Simple scroll cutting
3. Saber sawing
4. Angle sawing
5. Marquetry work
6. Sanding and filing

XVII. Using the wood-turning lathe

1. Sharpening turning tools
2. Centering and mounting stock
3. Turning a plain cylinder
4. Shoulder cuts
5. Taper cuts
6. Concave cuts
7. Convex cuts
8. Turning duplicate parts
9. Split turnings
10. Turning on faceplate
11. Chucking
12. Sanding and finishing

XVIII. Using the drill press

1. Boring holes
2. Mortising
3. Routing
4. Shaping
5. Sanding

PROCESSES AND OPERATIONS (Cont.)

XIX. Using the shaper
1. Adjusting the machine
2. Cutting grooves and rabbets
3. Shaping a straight edge
4. Shaping a curved edge
5. Shaping with patterns
6. Fluting and reeding

XX. Using the router
1. Veining and fluting
2. Cutting grooves
3. Cutting recesses
4. Shaping edges

INFORMATION

I. Wood
1. State and national forests
2. Reforestation
3. Kinds and habitat of American grown trees
4. Growth of trees
5. Uses and characteristics of various woods
6. Lumber camps
   a. How lumbering is done
   b. Life in lumber camps
   c. Wages of lumbermen
7. Milling
   a. How lumber is cut and seasoned
   b. Plain and quarter sawing
8. Standard sizes of lumber
9. Lumber defects
10. Grades of lumber
11. Plywoods and veneers
12. Synthetic woods
13. Selling lumber
   a. Figuring board feet
   b. Terms used
   c. How prices are quoted

II. Drawing and laying out
1. Kinds of drawings
2. Blueprints
3. Laying out tools
   a. Kinds, uses, and sizes
   b. Materials used in manufacture
   c. Current prices and makes

III. Saws
1. Kinds, uses, and sizes
2. Steel used in the construction of saw blades
3. How saw blades are tempered
4. Durability of saws
5. Filing saws by machines
6. Current prices
7. Standard brands

IV. Planes
1. Kinds, uses, and sizes
2. History
3. Materials used in manufacture
4. Current prices
5. Standard brands

V. Chisels and gouges
1. Kinds and uses
2. Sizes
3. Manufacture
4. Current prices

VI. Scrapers
1. Kinds and uses
2. History
3. Materials used in manufacture
4. Current prices

VII. Braces and bits
1. Kinds and uses
2. Early types of braces and bits

INFORMATION (Cont.)

3. Material used in manufacture
4. Durability of bits and drills
5. Current prices
6. Standard brands

VIII. Other hand tools
(Hammers, mallets, nail sets, levels, hand drills, etc.)
1. Kinds and sizes
2. Use and care
3. Current prices

IX. Maintenance of tools
1. Filing.
a. Kinds of files
(1) Materials used in manufacture
(2) Various types and uses
b. History of files
c. How files are made
d. How files are sold
(1) Grades
(2) Sizes
(3) Current prices
2. Grinding
a. Kinds of grinders
b. Types of grinding wheels
c. Speeds of grinding wheels
d. How grinding wheels are sold
(1) Grades and bonds
(2) Sizes
(3) Current prices
3. Whetting
a. Kinds of stones
b. Lubricants used on stones
c. How whetting stones are sold
(1) Grades
(2) Sizes
(3) Current prices

X. Clamping devices
1. Types and kinds
2. Trade names
3. Sizes
4. Current prices

XI. Abrasives
1. Manufacturing processes
a. Materials
b. Grades
c. Finished forms
2. Early methods of sanding
3. How sold
a. How prices are quoted
b. Current prices
4. Sanding machines

XII. Common fastenings for woodworking
1. Joints
a. Kinds and uses
b. Early methods of fastening
2. Glue
a. Kinds and uses
b. Grades
c. Forms
d. Methods of manufacturing and preparation
e. How glue is sold
(1) Quantities
(2) Current prices

XIII. Common woodworking hardware (braces, plates, locks, etc.)
1. Kinds and uses
2. Materials from which manufactured
3. How sold
a. Quantities
b. Current prices

XIV. Wood finishing
1. Stain
a. Kinds and source

INFORMATION (Cont.)

b. Purposes
c. Methods of preparation

2. Fillers
   a. Kinds and source
   b. Purposes
   c. How prepared
   d. How sold
   e. Current prices
3. Opaque and transparent finishing material
   a. Kinds
   b. How selected
   c. Manufacture
   d. Prices
4. Equipment used in finishing
   a. Hand
   b. Production

XV. Upholstery

1. Kinds of tools used
2. Source and kinds of materials
3. Methods
4. Costs
5. Care and repair

XVI. Woodworking machinery

1. Types, sizes, cost
2. Safety rules
3. Range of work possible
4. Maintenance problems
5. Manufacture

XVII. Problems in design

1. Distinguishing characteristics of period furniture
2. Trends in design and construction
3. Modern design
4. Factors that influence design
5. New materials

XVIII. Carpentry

1. Foundations
2. Simple framing
3. Exterior covering and finishing
4. Interior finish
5. Estimating

XIX. Millwork

1. Doors and windows
   a. Kinds and uses
   b. Sizes
   c. Construction
2. Cabinets, stair rails, etc.
3. Production woodwork

XX. Factors to consider in the purchase of furniture and other wood products

XXI. Influence of the development of synthetic materials on the woodworking trades and industries

SUGGESTED PROJECTS

I. Toys, games, puzzles

II. Boats, kites, airplanes, bows and arrows

III. Household articles and bric-a-brac

IV. Furniture

V. Models

VI. Wood patterns

VII. Scale model construction in carpentry

VIII. Home workshop equipment

IX. Farm equipment

X. School equipment

XI. Playground equipment

XII. Community projects

3. METALS

The various fields of metal work have played an important role in the development of our present civilization. Today millions of people are employed in the metal working industries and the products they produce influence the lives of every individual.

To aid in the description of this area the material has been classified under the heading of (sheet, bench, and art metal) (hot metals) and (machine tool work).

PROCESSES AND OPERATIONS

Sheet, Bench, and Art Metal

I. Planning and laying out
   1. Reading a working drawing
   2. Making a working drawing sketch
   3. Making a bill of materials
   4. Estimating costs
   5. Planning procedures
   6. Using layout tools
      a. Steel rule
      b. Circumference rule
      c. Steel square
      d. Combination square
      e. Scriber
      f. Dividers
      g. Center punch
   7. Layout methods
      a. Pattern
      b. Direct
      c. Radial developments
      d. Parallel line developments.
      e. Triangulation

II. Cutting
   1. Hand snips
   2. Bench lever shears
   3. Cold chisel
   4. Hack saw
      a. Selecting and adjusting blade
      b. Clamping work
   5. Jewelers' saw
   6. Squaring shears
   7. Shearing with vise and chisel

III. Folding
   1. Hand
      a. Straight edge
      b. Jigs
      c. Hand folder
   2. Machines
      a. Bar folder
      b. Cornice brake

IV. Forming
   1. Hand
      a. Stakes
      b. Hammers
      c. Mallets
   2. Slip roll
   3. Spinning

V. Wiring
   1. Hand method
   2. Turning machine
   3. Wiring machine

VI. Seaming and grooving
   1. Hand
   2. Machine

VII. Punching
   1. Hand
      a. Solid
      b. Hollow
   2. Lever

PROCESSES AND OPERATIONS (Cont.)

VIII. Riveting
- 1. Locate, and drill or punch holes
- 2. Setting rivet
- 3. Forming head

IX. Beading, crimping, burring, and setting down
- 1. Hand methods
- 2. Machine methods

X. Soldering
- 1. Lighting furnace and blow torch
- 2. Preparing and using flux
- 3. Tinning soldering coppers
- 4. Flowing solder
- 5. Tacking
- 6. Sweating

XI. Raising metal
- 1. Low raising
- 2. High raising

XII. Annealing
- 1. Heating
- 2. Cooling
  - a. Charcoal
  - b. Water and oil
  - c. Air
- 3. Cleaning and pickling

XIII. Bending and twisting
- 1. Vise and wrench
- 2. Jigs

XIV. Decorating
- 1. Peening
- 2. Doming
- 3. Beating down
- 4. Chasing
- 5. Engraving
- 6. Etching

XV. Finishing
- 1. Planishing
- 2. Pickling
- 3. Buffing
- 4. Polishing
- 5. Spot finishing
- 6. Oxidizing
  - a. Heat and fish oil
  - b. Liver of sulphur
  - c. Others
- 7. Enameling
- 8. Lacquering
- 9. Others

XVI. Drilling
- 1. Hand drill
- 2. Post drill
- 3. Hand electric drill

XVII. Filing
- 1. Selecting file
- 2. Clamping work
- 3. Cross filing
  - a. Flat surface
  - b. Curved surface
- 4. Draw filing
- 5. Cleaning file

XVIII. Grinding and sharpening tools
- 1. Chisels
- 2. Punches
- 3. Snips
- 4. Scribers
- 5. Drills
- 6. Adjust grinder
- 7. Dress grinding wheel

XIX. Cutting threads with taps and dies

XX. Metal spinning

PROCESSES AND OPERATIONS (Cont.)

Hot Metals

I. Forging
1. Lighting forge
2. Controlling fire
3. Heating stock
4. Upsetting
5. Drawing
6. Punching
7. Bending
8. Cutting
9. Shaping
   a. Vises
   b. Flatters
   c. Swages
   d. Fullers
10. Welding
11. Annealing
12. Tempering
13. Finishing

II. Welding (Gas)
1. Preparing equipment
2. Preparing stock
3. Lighting and adjusting torch
4. Preheating
5. Low temperature fusion
6. Brazing
7. High temperature welding
8. Cutting

III. Welding (Arc)
1. Preparing equipment
2. Clamping and setting-up stock
3. Adjusting welder
4. Striking arc
5. Running a bead
6. Making welds
   a. Flat edge
   b. Butt
   c. Lap
   d. Fillet
   e. Others

IV. Foundry
1. Planning and making pattern
2. Tempering sand
3. Ramming drag
4. Ramming cope
5. Removing pattern
6. Cutting runners, sprews and risers
7. Making and placing cores
8. Repairing mold
9. Closing mold
10. Lighting and loading furnace
11. Fluxing metal
12. Pouring
13. Trimming sprues and cleaning casting

Machine Tools

I. Drill press
1. Centering and chucking
2. Clamping stock
3. Straight drilling
4. Tap-drilling
5. Countersinking
6. Spot facing
7. Reaming
8. Using jigs and fixtures
9. Sharpening drills

II. Engine lathe
1. Adjusting machine
2. Centering work
3. Sharpening tools
4. Adjusting tool holder
5. Rough turning
6. Cutting off
7. Straight turning
8. Taper turning
   a. Off set tail stock
   b. Use compound rest
   c. Tapering attachment
9. Finish turning
10. Filing
11. Thread cutting (external)

PROCESSES AND OPERATIONS (Cont.)

12. Turning fillets
13. Chucking
14. Reaming
15. Drilling
16. Boring
17. Internal
18. Cutting key ways
19. Facing
20. Eccentric turning
21. Internal tapering
22. Knurling
23. Using back rest and steady rest
24. Cutting bevels
25. Spherical turning

III. Shaper

1. Setting up work
2. Adjusting speed and feed
3. Horizontal cuts
4. Vertical cuts
5. Angular cuts
6. Keyway cutting
7. Curved work

IV. Arbor press

1. Bushings and bearings
2. Gears and pulleys
3. Straightening shafts

V. Milling machine

1. Setting up work
2. Setting cutter and adjusting machine
3. Regulating coolant
4. Surfacing
5. Side milling
6. Vertical milling
7. End milling
8. Drilling, reaming and boring
9. Angular milling
10. Circular milling
11. Straddle milling
12. Simple, compound and differential indexing
13. Gear cutting
14. Threading

VI. Grinders

1. Grinding machine tool bits
2. Grinding external cylinder
3. Grinding internal cylinder
4. Grinding external taper
5. Grinding internal taper
6. Surface grinding
7. Cam grinding
8. Taper transverse grinding
9. Shoulder grinding
10. Cutter grinding

VII. Precision layout and checking

1. Using micrometer (external)
2. Using micrometer (internal)
3. Using vernier depth and height gauge
4. Using surface plate
5. Using surface gauges
6. Using steel squares

INFORMATION

Sheet, Bench, and Art Metal

I. How steel is processed

1. Iron ore
   a. Mining
   b. Transporting
2. Making pig iron
3. Making steel
   a. Bessemer
   b. Open hearth
   c. Electric furnace
4. Steel alloys
5. Standard grades
   a. Hot rolled
   b. Cold rolled
   c. Tool steel
   d. Drill rod
   e. Alloys
   f. Others

INFORMATION (Cont.)

II. Common uses of iron and steel
  1. Castings
  2. Sheet and plates
  3. Rods, bars, and wire
  4. Forgings
  5. Extrusions
  6. Others
  7. Manufacturers and costs

III. Manufacture and processing non-ferrous metals
  1. Mining ore and smelting
    a. Aluminum
    b. Copper
    c. Lead
    d. Tin
  2. Refining and processing
    a. Aluminum and alloys
    b. Brass
    c. Copper
    d. Bronze
    e. Pewter
    f. German silver
    g. Others
  3. Common uses
    a. Castings
    b. Sheets
    c. Rods, bars
    d. Forgings
    e. Extrusions
    f. Manufacturers and costs

IV. Standard sizes, grades, and prices of metal stocks
  1. Sheets and plates
  2. Rods, bars, wire
  3. Band iron
  4. Extrusions

V. Drawings for metal work
  1. Pattern and developments
  2. Forging
  3. Detail
  4. Assembly
  5. Special

VI. Laying out tools
  1. Kinds, uses, and sizes
  2. Materials used in manufacture
  3. Current prices and makes

VII. Cutting metal
  1. Hand tools (sizes, uses, grades, makes, costs)
    a. Snips and shears
    b. Chisels
    c. Hacksaw and blades
    d. Jewelers' saw
    e. Others
  2. Machine tools
    a. Power shears
    b. Stamping
  3. Production methods in industry

VIII. Sheet metal fabrication
  1. Hand tools (sizes, uses, makes, grades, costs)
  2. Machines (sizes, makes, costs, uses)
  3. Folding methods
  4. Wiring
    a. Purpose
    b. Methods
  5. Seams
    a. Purpose
    b. Methods
  6. Punching
  7. Riveting
    a. Rivet sizes
    b. Kinds and uses
    c. Selection
    d. Costs
  8. Beading and crimping, burring and setting down
    a. Purposes
    b. Methods
  9. Solder and flux
    a. Makes
    b. Uses
    c. Costs
  10. Sheet metal products
  11. Production methods

INFORMATION (Cont.)

Hot Metals

I. Forging
  1. Advantages and uses of forgings in industry
  2. Forges
    a. Types and sizes
    b. Costs
    c. Fuels
  3. Hand tools
    a. Kinds and sizes
    b. Costs
  4. Forging metals
    a. Kinds
    b. Characteristics and structure
    c. Grain refinement
    d. Flow lines or fiber
  5. Heat control
    a. Rate of heating
    b. Forging temperatures
    c. Measuring temperatures
    d. Annealing and normalizing
  6. Forging in industry
    a. Power hammers
    b. Drop forging
    c. Hydraulic forging presses
    d. Forging machines and appliances
    e. Dies
    f. Forging design
    g. Coining and straightening
    h. Inspection

II. Welding (Gas)
  1. Equipment
    a. Sizes and uses
    b. Cost
  2. Production of acetylene gas and oxygen
    a. Manufacture
    b. Generators
    c. Distribution
    d. Cost
  3. Selection and uses of welding rods
    a. Properties of metal
    b. Manufacture
    c. Size and identification
    d. Costs
  4. Fluxes
    a. Kinds
    b. Purpose
  5. Types of welds
  6. Designing jigs
  7. Welding in industry
    a. Cutting and burning
    b. Hard-surfacing
    c. Metal spraying
    d. Cutting under water
    e. Atomic hydrogen process
    f. Others

III. Welding (Arc)
  1. Equipment
    a. Types
    b. Uses
    c. Costs
  2. Electrodes
    a. Kinds
    b. Sizes
    c. Costs
  3. Types of welds
  4. Holding jigs
  5. Welding in industry
    a. Flash welds
    b. Spot welds
    c. Welding machines
    d. Welded products
    e. Inspection

IV. Foundry
  1. Molding equipment
    a. Sizes
    b. Kinds
    c. Costs
  2. Materials
    a. Iron and steel
    b. Non-ferrous metals
    c. Molding sands

INFORMATION (Cont.)

3. Melting equipment
   a. School types
   b. Industrial types
   c. Costs
   d. Fuels
4. Types of patterns
5. Core making
6. Molding machines
7. Die casting and permanent molds
8. Cleaning castings
9. Heat treatment
10. Inspection

Machine Tools

I. Machine shop materials
   1. Cast iron
   2. Steels
   3. Non-ferrous castings
   4. S.A.E. standards
   5. Cutting tool materials
      a. High carbon
      b. High speed
      c. Stellite
      d. Carbides
      e. Others
   6. Costs

II. Cutting speeds and feeds

III. Measuring devices
   1. Semi-precision
   2. Precision measuring and layout
   3. Comparators

IV. Kinds of fits and fitting

V. The lathe
   1. Types
   2. Parts
   3. Sizes
   4. Costs and makes
   5. Lathe work in industry

VI. The shaper
   1. Parts
   2. Sizes
   3. Cost and makes
   4. Industrial machines

VII. The milling machine
   1. Types
   2. Parts and attachments
   3. Sizes, makes, and cost
   4. Types of cutters
   5. Gear tooth forms
   6. Computation of speeds, feeds, and indexing
   7. Industrial milling processes

VIII. The grinder
   1. Types
   2. Parts and attachments
   3. Sizes, makes, and costs
   4. Abrasives
      a. Bond
      b. Grade
      c. Shapes
   5. Grinding in industry

IX. Machine tools in industry
   1. Automatic and semi-automatic lathes
   2. Drilling machines
   3. Turret lathes
   4. Centerless grinders
   5. Magnetic chucks
   6. Broaching machines
   7. Inspection methods
   8. Others

SUGGESTED PROJECTS

I. Sheet, Bench and Art Metal
   1. Tool tray
   2. Watering can
   3. Funnel
   4. Mail box
   5. Tool box
   6. Scribers
   7. Dividers
   8. Hammer
   9. Bracket
   10. Garden trowel
   11. Camp grate
   12. Foot scraper
   13. Pin-up lamps
   14. Book ends
   15. Candle holder

SUGGESTED PROJECTS (Cont.)

16. Flower pot holder
17. Lamps
18. Trays
19. Bowls
20. Letter opener

II. Hot Metals

1. Chisels
2. Punches
3. Hooks
4. Hinges
5. Fireplace set
6. Paper weights
7. Book ends
8. Placques
9. Repair jobs
10. Frames and brackets

III. Machine Tools

1. Drill gauge
2. Snap gauge
3. Rivet set
4. Nail set
5. Wire gauge
6. Riveting hammer
7. Setting down hammer
8. Drill drift
9. Parallel clamps
10. Towel racks
11. Coping saw frame
12. Machinist's clamp
13. Small anvil
14. Tap wrench
15. Center punch
16. Solid punch
17. Prick punch
18. Hollow punch
19. Scratch awl
20. Hand groover
21. Monkey wrench
22. Flat wrench
23. Hack saw frame
24. Plumb bob
25. Ball pein hammer
26. Cross pein hammer
27. Cap screw
28. Lathe center
29. V blocks
30. Toolmakers vise
31. Screwdriver
32. Boring tool holder

4. ELECTRICITY

Electricity, the miracle of our modern day, furnishes light. power, heat, and carries communications long distances in a split second. 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. The experiences in this area should provide them with an understanding of this great industry, and information that will aid them in the selection, care, and use of its many products. The projects and problems that the student chooses will determine to some extent the principles and information to which he will give attention.

PRINCIPLES AND PROCESSES

I. The nature of electricity
   1. Kinds of electricity
      a. Static
      b. Positive—negative
      c. Current
         (1) Direct
         (2) Alternating
   2. The electron theory
      a. Molecules
      b. Protons
      c. Atoms
      d. Electrons

II. Ohm's law
   1. Current
      a. Ampere

PRINCIPLES AND PROCESSES (Cont.)

- b. Measurement
- c. Laws that govern current
- d. Practical uses
- e. Reading an ammeter

2. Voltage
   - a. Volt
   - b. Measurement
   - c. Laws that govern voltage
   - d. Practical uses and value
   - e. Reading a volt meter
3. Resistance
   - a. Ohm
   - b. Measurement
   - c. Laws that govern resistance
   - d. Practical uses and values
     - (1) Control flow of current
     - (2) Production of heat
4. The power equation
   - a. The watt
   - b. The kilowatt
   - c. The kilowatt-hour
   - d. Calculation and measurement of electrical power
5. Electrical symbols

III. Electro-chemistry

1. Primary and secondary cells
2. Storage batteries
   - a. Lead cells
   - b. Edison cells
   - c. Ratings
   - d. Care and use
3. Polarization and local action
4. Electrolysis
   - a. Electrolytes
   - b. Electroplating

IV. Conductors and electrical circuits

1. Materials used as conductors
   - a. Good conductors
   - b. Poor conductors
   - c. Insulators
2. Wire and wire sizes
   - a. The wire table
   - b. The mil
   - c. The circular mil (mil foot)
   - d. Rules involved
   - e. Splicing wire
   - f. Removing insulation
   - g. Soldering connections
3. Kinds of circuits
   - a. Series
   - b. Parallel
   - c. Combination
   - d. Laws applying to circuits
4. Protection of circuits
   - a. Fuses
   - b. Insulation
5. Circuit troubles

V. Crystal set circuits

1. Testing crystals
2. Types of circuits
3. Testing variable condensers
4. Testing fixed condensers
5. Explanation of circuits

VI. Magnets and magnetism

1. Nature of magnetism
   - a. Materials used for magnets
   - b. Attraction and repulsion
   - c. Poles
   - d. Lines of force
   - e. Magnetic field

VII. Types of magnets

1. Natural magnets
2. Artificial magnets

PRINCIPLES AND PROCESSES (Cont.)

a. Permanent
b. Electromagnets
(1) Fields
(2) Right hand rule
(3) Generator and motor fields

VIII. The motor

1. Types of motors
a. Direct current
(1) Principles
(2) Commutator construction
(3) Fields
(4) Armature
(5) Armature windings
b. Alternating current
(1) Types of A.C. motors
(2) Split phase motors
(3) Repulsion induction motors
(4) Repulsion motors
c. Types of D.C. motors
(1) Shunt
(2) Series
(3) Compound
2. Protecting motors from overload
3. Starting boxes
4. Automatic controlling apparatus
5. Reversing motors
6. Care of motors
7. Rewinding motors

IX. The generator

1. Electromagnetic induction
2. Collecting rings and commutators
3. Action within an armature
4. Setting the brushes
5. Field excitation
6. Shunt, series and compound
7. Changing from A.C. to D.C.

X. The transformer

1. Use of transformers
2. Principles of transformer operation
a. Electric current and magnetic field
b. Magnetic lines of force
c. Magnetic conductivity
d. Magnetic induction
e. Induced current
f. Magnetic flux
3. The primary and secondary coils
4. Transformer voltages
5. Transformers in parallel
6. Principles of induction coil
a. Breaker points
b. Condenser
7. Efficiency
8. Operation
9. Commercial types

XI. Bells and buzzers

1. Parts of an electric bell or buzzer
2. How electricity rings a bell
3. The circuit
4. Connections
5. Source of current
6. Wiring bell circuits

XII. Distribution systems

1. The central power plant
2. The customer's needs
3. Wiring systems
a. Two wire
b. Three wire
c. Three phase

PRINCIPLES AND PROCESSES (Cont.)

4. Distribution transformers
5. Street lighting
6. Emergency service

XIII. Electricity in the home and on the farm

1. Lighting
   a. Candle power
   b. Principles of light control
   c. Lighting systems and devices
2. Appliances (purchase, care, and repair)
   a. Stoves
   b. Refrigerators
   c. Vacuum cleaners
   d. Radios and telephone
   e. Water pumps
   f. Milking machines
   g. Others
3. Circuits
   a. Selecting and installing fuses
   b. Installing switches
   c. Installing convenience outlets
   d. Short circuits
   e. "Western Union" splice
4. Repairing electrical devices
   a. Tying underwriter's knot
   b. Wiring lamp socket
   c. Wiring appliance plug
   d. Cleaning and oiling motors
   e. Replacing attachment cord
   f. Repairs that should be made by the expert electrician

XIV. Radio

1. Purpose of parts
   a. Coil
   b. Variable condenser
   c. Crystal
   d. Fixed condenser
   e. Aerial and ground
2. Characteristics of radio waves
   a. Produced at broadcasting station
   b. Frequency and wave length
   c. Travel through space
      (1) Heaviside layer
      (2) Effects of sun spots
      (3) Skip distance
      (4) Reception at sunrise and sunset
      (5) Fading
3. Rectifying tubes
   a. Principle of tubes
   b. How they operate
   c. Output
   d. Chokes
   e. Filtering condensers
4. Detector tubes
   a. Purposes
   b. Principles
   c. Amplification of a signal
5. Tuning of radio
   a. Length of aerial
   b. Movable coil
   c. Variable condenser
      (1) Capacity
      (2) Inductance
   d. Regeneration
6. Theory of a 4 tube alternating current (A.C)—direct current (D.C.) 110 V. T.R.F. Circuit
   a. Through stages, radio frequency (R.F) detector, audio frequency (A.F.)

PRINCIPLES AND PROCESSES (Cont.)

b. Stages of superheterodyne circuit
7. Theory of 4 tube battery operated radio
a. One tube detector
b. One stage of audio frequency (A.F.)
c. One stage of radio frequency (R.F.)
d. Two stages of audio frequency (A.F.)
e. Methods of coupling
f. Wave bands
8. Type volume controls
a. Control of filament voltage
b. Control of plate voltage
c. Control grid potential of second stage
d. Control of antenna coil inductance
e. Control of coil inductance and cathode bias
9. Radio tubes
a. Classification as to structure
b. Classification as to function
c. Function of individual parts of a tube
(1) Cathode
(2) Filament
(3) Plate
(4) Grids
10. Theory of the 4 tube superheterodyne circuit
11. Power supplies

INFORMATION

I. General

1. Early developments in the electrical field
2. Men responsible for early developments
3. Industrial applications of the storage cell
4. Manufacture of dry cells
5. Action of acids on skin and clothing
6. Sizes of wire
7. Manufacture of wire
8. Materials used for insulation
9. Types of insulated wire
10. High line construction
11. Commercial use of rheostats
12. Use of annunciators
13. Natural magnets, their action and use
14. Commercial uses of the electro- and permanent magnet
15. Manufacture of electric welding
16. Manufacture of electric lamps
17. Principles of good lighting
18. Automatic heat controls
19. Codes governing wiring
20. House wiring as a trade
21. Electrical work as a vocation
22. Principles and application of the electric cell
23. Development of the telephone and telegraph
24. Modern telephone systems
25. History of electric lighting
26. History of the motor and generator

II. Radio

1. Prominent inventors in the radio field
2. Development of the radio
3. Construction of microphone and receiver

INFORMATION (Cont.)

4. Radio waves
5. Rectification
6. Amplification
7. Principles of the vacuum tube.
8. Radio symbols and their meaning
9. Visit to a broadcasting station
10. The theory of television
11. Federal control of radio
12. The future of radio
13. The use of radio in modern war

SUGGESTED PROJECTS

I. General

1. Electro-magnets
2. Storage battery cell
3. Current detector
4. Arc light
5. Arc welder
6. Magnetic compass
7. Rheostat
8. Magnetic motor
9. A.C.—D.C. motor (simple)
10. Transformer
11. Water heater
12. Soldering copper
13. Current control for soldering iron
14. Electric fence control
15. Battery charger
16. Grills and toasters
17. Buzzers and door chimes
18. Burglar alarms
19. Defrosters
20. Testing panels

II. Radio

1. Code sets
2. Crystal radio set
3. One tube radio set
4. More than one tube sets
5. Short wave sets
6. Testing panels

5. CRAFTS

The various crafts provide desirable activities in industrial arts. They are highly interesting to the students and offer many possibilities for the development of avocational activities. They provide for creative activity as well as for the study of many industrial materials and products.

Craft work should place equal emphasis upon the importance of good design and the mastery of skills involved in the manipulation of tools and materials. Among other things, good craft work must (1) serve some useful purpose, (2) be made of durable or adequate materials, (3) embody characteristics that give the student some satisfaction.

Only a few of the most common crafts are described in this handbook. Many teachers will be able to extend the scope of offerings in this area.

LEATHER

PROCESSES AND OPERATIONS

I. Planning and developing design

II. Transferring the pattern
1. Preparing the pattern
2. Moistening the leather
3. Applying the pattern to the leather

III. Tooling
1. Tooling curved lines
2. Tooling straight lines
3. Stippling
4. Stamping background

IV. Lacing
1. Laying out
2. Punching holes
3. Over-and-over lacing
4. Securing the end
5. Pierced splicing
6. Loop lacing
7. Splicing loop lacing
8. Repairing broken holes
9. Gluing edges

V. Using accessories
1. Setting snaps
2. Setting eyelets
3. Setting rivets
4. Mounting hardware

VI. Using the knife and shears
1. Cutting project from leather blank
2. Cutting fringe
3. Carving

VII. Braiding
1. Making a flat braid with 4 strands
2. Making a round braid with 4 strands
3. Making a box or square braid with 4 strands
4. Other types

VIII. Finishing
1. Applying dye
2. Applying lacquer
3. Applying wax

INFORMATION

I. History and manufacture of leather
1. Early methods of tanning
2. Source of materials
3. Modern methods
4. Costs

II. Kinds, characteristics, and uses of leather
1. Calf skin
2. Cow hide
3. Sheep hide
4. Pig skin
5. Steer hide
6. Others

III. Production method of fabrication

IV. Dyes and stains
1. Water
2. Oil
3. Spirit
4. Inks
5. Others

V. Tools and equipment
1. Machine tools
2. Hand tools
3. Sizes, brands, and costs

VI. Selection, care, and use of leather articles

SUGGESTED PROJECTS

Bookmark
Wristband
Coin purse
Lady's change purse
Key case (with key hooks)
Key case (with binding posts)

LEATHER (Cont.)

SUGGESTED PROJECTS (Cont.)

Wallet
Cowhide belt
Lanyards of several types
Knife sheath
Ax sheath
Carved doily
Watch chain
Link belt

PLASTICS

PROCESSES OF OPERATIONS

I. Designing plastic articles
   1. Stock sizes, shapes, and colors
   2. Combining plastics with wood and metal
   3. Construction problems

II. Laying out stock
   1. Using scratch awls and squares
   2. Masking
   3. Contour patterns
   4. Cylinders

III. Cutting out stock
   1. Using hacksaw
   2. Using backsaw
   3. Using jeweler's saw
   4. Using power equipment

IV. Squaring stock
   1. Using plane
   2. Using file
   3. Using chisel
   4. Using sandpaper

V. Drilling and countersinking holes
   1. Using hand drill
   2. Using power drill
   3. Using auger bits
   4. Using countersink

VI. Threading and tapping
   1. Clamping and holding material
   2. Using tap and die set
   3. Using self-tapping screws

VII. General operations
   1. Cutting grooves
   2. Veining
   3. Carving
   4. Inlaying
   5. Overlaying

VIII. Forming and bending
   1. Building jigs and forms
   2. Heating plastic
   3. Bending procedure
   4. Embossing

IX. Using dyes

X. Surfacing and finishing
   1. Hand and machine sanding
   2. Ashing
   3. Buffing

XI. Assembling
   1. Selecting cement
   2. Preparing joint
   3. Applying cement and clamping
   4. Using machine screws
   5. Using self-tapping screws
   6. Using drive screws

INFORMATION

I. History and development of plastics

II. Kinds and classification
   1. Natural resins
   2. Artificial resinoids
   3. Working qualities

III. Basic materials and manufacture
   1. Binders and fillers
   2. Dyes and pigments
   3. Plasticizers and solvents
   4. Catalysts and hardeners
   5. Source of raw materials

PLASTICS (Cont.)

SUGGESTED PROJECTS

Paper weights
Letter openers and holders
Rings and pins
Bracelets and brooches
Book ends
Boxes and trays
Cribbage boards
Candle stick holders

IV. Tools, equipment and supplies
    1. Grades and sizes
    2. Makes
    3. Costs

V. Industrial production methods
    1. Compression and transfer molding
    2. Injection molding
    3. Laminated plastics
    4. Finishing and decorating methods

VI. Plastic products and their uses

Pin-up lamps
Desk lamps
Desk sets
Drawer pulls
Clock cases
Salt and pepper sets
Tableware
Small tables

III. Forming
    1. Coil
    2. Slab
    3. Throwing
    4. Casting and mold building
    5. Attaching appendages
    6. Jiggering flat ware
        a. Inside
        b. Outside
    7. Jiggering hollow ware

IV. Casting

V. Decoration and surface enrichment
    1. On damp clay
        a. Inlaying
        b. Sgraffito
        c. Embossing
    2. On dry clay
        a. Slip painting
        b. Underglaze
        c. Stanniferous painting
        d. Overglaze

VI. Drying

VII. Operating and stacking the kiln

VIII. Firing
    1. Biscuit
    2. Glost
    3. Temperature and cones
    4. Stoneware
    5. Earthenware

CERAMICS

PROCESSES AND OPERATIONS

I. Designing and planning
II. Preparing clay
    1. Amount
    2. Moisture content
    3. Consistency
    4. Wedging
    5. Working on plaster bat

INFORMATION

I. History of ceramics
II. Industry of ceramics
III. Melting of common materials
IV. Color combinations
V. Special modeling and casting
VI. Definitions and terms

INFORMATION (Cont.)

VII. Ceramics as a hobby
VIII. Ceramics as a business
IX. Design

SUGGESTED PROJECTS

Vases
Relish dishes
Cups (tea and coffee)
Book ends
Teapots
Figurines
Paper weights
Jewel boxes

BOOKBINDING

PROCESSES AND OPERATIONS

I. Filling out the bindery record card

II. Preliminary steps in binding

III. Selecting method and sewing
1. Applying double end sheets—no sewing
2. Sewing on end sheets
3. Flat stitching
4. Machine stitch
5. Overcast
6. Nailing
7. Loom sewing
8. Saddle stitch

IV. Binding operations other than sewing
1. Cutting end sheets
2. Applying the double end sheets
3. Applying the backing flannel
4. Trimming the book
5. Sanding the book
6. Rounding the book
7. Applying the headbands
8. Spring back
9. Cutting the cover boards
10. Cutting binding materials
11. Lettering strip
12. Making up the cover
a. Turning corners
b. Gluing covers and end sheets
c. Marking cover boards
13. Hanging-in the book
14. Gluing up the end sheets
15. Pressing and cleaning the book

V. Using bindery equipment
1. Board shears
2. Combination backer and press
3. Loom
4. Standing press
5. Lettering machine
6. Bench shears
7. V-punching trough
8. Case-making gauge
9. Adjustable punching guide
10. Finishers clamp
11. Electric glue pot
12. Stabbing machine
13. Finishing rolls
14. Hand pallet
15. Habagraph

VI. Using hand tools
1. Shears
2. Scratch awl
3. Bone folder
4. Back saw
5. Cobbler's hammer
6. Skiving knife
7. Dividers
8. Pliers
9. Oyster knife
10. Backing hammer

VII. Repairing books
1. Torn pages
2. Loose pages
3. Worn or broken covers
4. Cover loose at joint
5. Collector's items

INFORMATION (Cont.)

INFORMATION

I. History and importance of the binding of books

II. Commercial book binding

III. Design in book binding

IV. Materials, their use, and manufacture
  1. Types of bindings
    a. Quarter-bound books
    b. Half-bound books
    c. Three-quarter-bound books
    d. Full-bound books

V. Stock sizes, colors, qualities, and prices

VI. Kinds of type and use of each

VII. Binding of books as a hobby

SUGGESTED PROJECTS

Single-section book
Loose-leaf binder
Hot-dish mats
Autograph book covers
Hard-cover notebooks
Bridge pad covers
Book marks
Photo albums
General binding (magazines, newspapers, etc.)

6. HOME AND FARM MECHANICS

This course should be of equal importance to both boys and girls. The primary purpose here is to relate the basic fundamentals of other areas of industrial arts to real life problems of living in the home. Many current problems of a wide variety found in the homes of the students can be studied and solved.

There will be considerable overlapping of elementary skills and basic procedures which were previously experienced in woodwork, metalwork, and electricity, but the applications are more universal as they reach the life of every homemaker. Much of the equipment and materials also can be supplied from these other areas.

The farm mechanics problems presented are especially prepared for schools not sponsoring a vocational agricultural program. It is assumed that the industrial arts instructor will select those repair, construction, or maintenance problems which are especially adapted to the farming needs of the local community. Much of the farm mechanics subject matter can be brought in by interested students.

PROBLEMS AND PROCESSES

I. Packing, wrapping, and tying packages
   1. Mailing
   2. Storage and moving
   3. Express

II. Repairing furniture
   1. Glue and clamp loose joint or broken parts
   2. Apply various types of metal braces
   3. Repairing defects with stick shellac, water putty, plastic wood, etc.
   4. Replace hardware such as hinges, drawer pulls, catches, glides, etc.
   5. Adjust drawers and doors that stick or sag
   6. Fasten with nails, screws, and other fasteners

III. Finishing and refinishing
   1. Preparing surface
      a. New
      b. Old
   2. Selecting and using abrasives
   3. Selecting and applying finish
      a. Stain
      b. Filler
      c. Varnish
      d. Enamel
      e. Outside paints
      f. Others
   4. Removing old paint and varnish
   5. Care of brushes

IV. Plumbing
   1. Repairing
      a. Faucets and valves
      b. Pipes and tanks
      c. Flushing tank
      d. Traps and drains
   2. Practical home plumbing
      a. Laying out and cutting pipe
      b. Threading
      c. Assembling
   3. Insulating water and heating pipes
   4. Closing a house for winter
   5. Thawing frozen water pipes

V. Cleaning and care of:
   1. Furniture
   2. Metal ware
   3. Woodwork
   4. Upholstery
   5. Rugs
   6. Wall paper

VI. Repairing utensils with:
   1. Rivets
   2. Solder
   3. Welding
   4. Bolts

VII. Repairing holes in plaster, mortar, cement
   1. Mixtures for plaster, mortar, cement
   2. Preparing surfaces and areas to be repaired
   3. Buying materials—cement, sand, plaster, mortar
   4. Procedures in laying cement, patching cement, patching plaster, calking brick with mortar

VIII. Using and repairing electrical appliances and equipment
(Toasters, electric irons, heaters, vacuum sweepers, fans, radios, and other electrical appliances)

PROBLEMS AND PROCESSES (Cont.)

1. Select and install fuses
2. Install electric light socket
3. Install wall or floor plugs
4. Wire various bell or buzzer systems
5. Wire multiple socket lamps
6. Clean armature and replace brush on electric motors
7. Determine loads on an electric circuit

IX. Doors and windows

1. Tighten hinges and adjust doors to fit
2. Repair mortise lock
3. Install a screen door
4. Lubricate hinges and lock
5. Hang small door
6. Refit door that sticks
7. Recover lost window weights
8. Recondition window that sticks
9. Replace glass in window and putty
10. Make window screens
11. Hang curtains and shades

X. Safety in the home

1. Safety guards on machines
2. Safety practices in handling electricity, gas, water, steam, coal, oil, etc.
3. First aid kits and their proper use
4. Eliminating fire hazards

XI. The home workshop

1. Location
2. Minimum essentials
   a. Equipment
   b. Tools
   c. Supplies
3. Arrangement
4. Home made equipment
   a. Bench
   b. Cabinet
   c. Tool racks
   d. Shelves
   e. Lighting systems and outlets
5. Servicing garden tools
6. Sharpening of tools and knives
7. Power machines

XII. Home planning and remodeling

1. Floor plans and sketches for new homes
2. Remodeling plans and problems
3. Landscaping
4. Selecting the site
5. Procedure for procuring public utilities
6. Reading house plans

XIII. Farm mechanics

1. Sharpening farm tools
2. Fitting saws
3. Rope work
4. Harness repair and care
5. Belt lacing
6. Fitting farm tool handles
7. Repair of farm machines
8. Repair of farm buildings
9. Build small utility buildings
10. Carpentry problems
11. The farm workship

INFORMATION

I. Furniture
   1. Styles
   2. Materials
   3. Construction
   4. Finish
   5. Makes, costs

II. Nails, screws and other hardware
   1. Sizes
   2. Kinds and grades
   3. Costs

III. Finishing materials and brushes
   1. Manufacture
   2. Kinds and grades
   3. Uses
   4. Costs

IV. Abrasives
   1. Kind and use
   2. Grade
   3. Cost

V. Water service
   1. Sources of water supply
   2. Pumping stations
   3. Identification of plumbing fixtures, materials, and tools
   4. Water heaters and softeners
   5. Reading meters and figuring costs
   6. Sewage disposal systems
   7. Garbage disposal units

VI. Electrical service
   1. Power plants
   2. Reading meters
   3. Figuring costs
   4. Safety factors

VII. Electrical appliances
   1. Factors to consider in selection and purchase
   2. Care and use

VIII. Gas service
   1. Manufacture
   2. Reading meters
   3. Costs
   4. Safety factors

IX. Floors
   1. Kinds
   2. Characteristics
   3. Finishes
   4. Care

X. Doors, windows and screens
   1. Kinds and types
   2. Sizes
   3. Manufacturers
   4. Weatherproofing methods
   5. Locks

XI. Heating and ventilating the home

XII. Modern home insulation
   1. Kinds
   2. Methods
   3. Costs
   4. Reasons

XIII. Fire hazards in the home

XIV. Accidents in the home

XV. Tools and machines for the home workshop

XVI. Planning a farm workshop
   1. Machines
   2. Tools
   3. Arrangement
   4. Supplies

XVII. Harness and leather products
   1. Brands
   2. Types
   3. Costs

XVIII. Essentials of farm machinery maintenance

7. AUTOMOBILE MECHANICS

There are relatively few Americans whose economic efficiency does not depend directly or indirectly upon the intelligent use of the automobile, and there are practically none who do not look to it for a large share of their personal-social satisfaction. The public schools can easily justify the inclusion of work in automobile mechanics as a part of their industrial arts program. Such an offering would be the most efficient way to develop an appreciation and understanding of the modern automobile.

Boys of today have little or no opportunity to satisfy their curiosity or develop an understanding of the modern motor car. A generation ago there was a chance for the boy to help his father as he tinkered with the "model T" or the "490 Chevrolet." Through such a situation he was able to secure some understanding of the operation of the automobile. Today, however, the modern car has become so highly specialized and complicated in its construction that its operation remains much of a mystery to the younger generations.

The following suggested outline for the area of automobile mechanics has been divided into two parts:

Part I. A list of problems and information that could be presented by working on the family car which would be brought into the laboratory. This places considerable responsibility on student and teacher and the situation must be carefully planned and controlled. The nature of the work would be similar to that found in the modern service or filling station.

Part II. A list of possible processes, problems, and information that could be presented in the laboratory while working on dry motor blocks and an automobile chassis.

The two parts should be considered together and adapted to the local situation.

PART I

PROBLEMS AND PROCESSES

I. Washing
   1. Methods
   2. Soaps and washes
   3. Using equipment

II. Cleaning
   1. Exterior
      a. Finish
      b. Accessories
      c. Tires

PART I (Cont.)

PROBLEMS AND PROCESSES (Cont.)

2. Interior
   a. Floor
   b. Upholstery
   c. Glass and trim
   d. Accessories
   e. Replacing floor mat

III. Polishing
   1. Methods
   2. Kinds of polish
   3. Using polishing equipment
   4. Applying polish

IV. Lubricating
   1. Chassis
   2. Wheel bearing (pack)
   3. Transmission
   4. Differential
   5. Crankcase
   6. Replacing filter cartridge
   7. Steering gear
   8. Water pump
   9. Fan
   10. Air cleaner
   11. Shock absorbers
   12. Springs

V. Tires
   1. Checking for nails
   2. Checking for breaks and cuts
   3. Checking pressure
   4. Simple tire repairs
   5. Painting tires

VI. Battery
   1. Inspecting and filling
   2. Cleaning terminals
   3. Lubricating posts
   4. Checking and replacing cables

VII. Cooling system
   1. Replacing and adjusting fan belt
   2. Replacing and adjusting hose and hose connections
   3. Flushing radiator
   4. Checking antifreeze
   5. Filling with water

VIII. Defrosting unit
   1. Checking and replacing hose
   2. Checking for efficiency

IX. Heating unit
   1. Checking heater hose and connections
   2. Oiling fan

X. Lights
   1. Checking all lights
   2. Checking wires for shorts
   3. Replacing burned out bulbs
   4. Adjusting lights if needed
   5. Checking and replacing dimmer switch

XI. Brakes
   1. Checking
   2. Checking emergency
   3. Checking brake fluid
   4. Simple adjustments

XII. Spark plugs and ignition
   1. Testing plugs
   2. Cleaning
   3. Adjusting points
   4. Replacing burned plugs
   5. Replacing ignition wire

XIII. Fuel system
   1. Removing air cleaner and washing

PART I (Cont.)

PROBLEMS AND PROCESSES (Cont.)

2. Adjusting carburetor
3. Checking fuel lines for leaks
4. Oiling controls

XIV. Fender repair
1. Removing dents
2. Sanding
3. Applying undercoat
4. Painting
5. Rubbing down
6. Polishing

XV. Paint
1. Applying touch-up enamel

XVI. Upholstery
1. Cleaning
2. Replacing seat covers
3. Removing spots
4. Cleaning with vacuum

XVII. Door locks and hinges
1. Lubricating
2. Repairing or replacing
3. Adjusting

INFORMATION

I. Factors that are important in the proper care of the automobile
1. Lubrication
2. Washing and polishing
3. Paint
4. Upholstery
5. Accessories

II. Filling station services and products (grades, sizes, makes, costs, and uses)
1. Gasoline, oil, grease and other petroleum products
2. Tires, batteries, and fan belts
3. Waxes, cleaners, etc.
4. Others

III. Elementary theory of operation
1. Engine
2. Clutch
3. Transmission
4. Rear axle
5. Steering mechanism
6. Front axle
7. Brake system
8. Battery
9. Tires
10. Ignition
11. Lighting system
12. Generator
13. Starter
14. Carburetor

IV. Responsibility involved in automobile ownership
1. Individual financial responsibility
2. Iowa's new individual responsibility law
3. Insurance
4. Driver and pedestrian responsibility
5. Physical fitness
6. Condition of vehicle

V. Traffic regulations
1. Cities and towns
2. Highway
3. Law enforcement officials
4. Licenses
a. Passenger cars
b. Trucks
c. Trailers
d. Driver's
e. Chauffeur's

VI. Travel aids
1. Map study
2. Travel aids
3. Points of interest
4. Driving laws in other states

PART II

PROBLEMS AND PROCESSES

I. Chassis

1. Frame
   a. Examining frame
   b. Note type and construction
2. Front axle
   a. Disassembling, inspecting, reassembling
   b. Identifying parts
   c. Inspecting king pin
   d. Adjusting tie rod
3. Steering gear
   a. Disassembling, inspecting, reassembling
   b. Identifying parts
   c. Adjusting drag link
4. Brakes
   a. Disassembling, inspecting, reassembling
   b. Identifying parts
   c. Comparing mechanical and hydraulic systems
   d. Adjusting both types
5. Universal
   a. Disassembling, inspecting, reassembling
   b. Identifying parts
6. Transmission
   a. Disassembling, inspecting, reassembling
   b. Identifying parts
   c. Placing gears in different speeds while cover is removed
7. Clutch
   a. Disassembling, inspecting, reassembling
   b. Identifying parts
8. Springs and shock absorbers
   a. Disassembling, inspecting, reassembling
   b. Identifying parts
9. Wheels, rims, tires
   a. Removing and inspecting tires and tubes
   b. Inflating and checking pressure
   c. Patching and simple repairs
   d. Checking for balance

II. Starting and lighting units

1. Starter
   a. Disassembling, inspecting, reassembling
   b. Identifying parts
   c. Testing operation
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   b. Identifying parts
   c. Testing operation
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   e. Testing voltage regulator
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  - a. Removing
  - b. Inspecting
  - c. Cleaning
  - d. Replacing
- 3. Cylinder
  - a. Inspecting wall
  - b. Removing and replacing sleeve
- 4. Crank shaft
  - a. Inspecting
  - b. Checking rods
  - c. Adjusting bearings
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  - b. Inspecting
  - c. Cleaning
  - d. Replacing worn parts
  - e. Adjusting
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Chapter VI

PLANNING AND EQUIPPING THE INDUSTRIAL ARTS LABORATORY

Well defined and worthy objectives together with careful considerations of the content and method can not insure an adequate program in industrial arts. Proper housing and equipment is essential.

At the present time there are many administrators and school authorities in Iowa who are giving consideration to the expansion and improvement of the school plant. During the war years little was accomplished along this line and this has resulted in many building programs now in the planning or promotional stage. There are other factors, such as the trend toward consolidation of school districts, that will aid in the development of new, expanded, and improved school buildings in the next few years.

In this chapter an attempt will be made to define some of the problems peculiar to the industrial arts facility and provide answers and suggestions to these problems. As already pointed out in the introduction, most of the examples and detailed suggestions are aimed at the "one-teacher" situation. However, most of the considerations and principles will apply to any industrial arts department.

1. GENERAL CONSIDERATIONS

Size and Shape. Many factors must be considered in determining the size of the laboratory. In general, the minimum floor area required for each student should be between 80 and 100 square feet. This figure includes space allowed for storage, finishing, planning, and other auxiliary areas. As the total size of the area is reduced the amount of space for each student must necessarily increase.

Laboratories designed for operation by a single teacher should not exceed 3,000 square feet of floor space.

Those who are planning to improve and expand their industrial arts program by adding more areas of activity must understand that as these areas are added the total enrollment

must be reduced. For example, a laboratory which adequately handled 24 students in woodworking may provide facilities for only 18 to 20 students when areas of metalwork, crafts, and electricity are added.

The ideal shape for the laboratory would probably be square; however, because of architectural problems, cei'ing supports, and lighting, a rectangular shape is more practical. The proportions may vary between 1 to 1½ and 1 to 2. The width should not be less than 30 feet. Irregular shapes, such as L and U, should be avoided.

Location. The industrial arts laboratory should be located on the ground floor and preferably in a wing of the main building. This will make possible a separate outside entrance which is important to the areas of transportation and farm mechanics. This entrance will be useful in handling large pieces of equipment and receiving materials and supplies.

Basement rooms are considered unsatisfactory due to the difficulty of securing adequate, natural light. The problem of caring for materials and equipment is increased because of the higher humidity that usually exists. The health and safety of the students and instructor must also be considered in this matter.

Although the transmission of noise from the industrial arts laboratory to adjacent rooms can be effectively controlled, it is well to consider its location with respect to other areas in which the noise factor may be high.

Some schools have located their industrial arts laboratory in a separate building. This arrangement offers the advantage of lower insurance rates on the main building, a reduction in construction costs, and convenient use for out-of-school activities. However, the added costs of heating and maintenance, problems of administrative control, and the fact that this arrangement tends to place industrial arts apart from other school activities as something special and different, outweigh the advantages gained.

Safety. Safety factors must be given first consideration in all laboratory planning. Most important, of course, are those factors which are directly related to the well-being of the students and instructor. They will include such items as: equipment arrangement, aisles of travel, ventilation, heating,

noise, lighting, color, guarding, safety zones, and service facilities. There will be some safety factors which may point more directly toward the safeguarding of equipment, materials, and supplies. Desirable standards in regard to some of these items will be discussed under other headings.

Such machines as the table saw, jointer, lathe, hacksaw, and shaper must be arranged to eliminate, in so far as possible, students being in the line of danger. For example, the position of the table saw should be such that a block of wood "kicked-back" from the blade, would not travel across the room endangering other students. Safety zones should be indicated on the floor with bright colored lines. They should be so designed as to allow the student to operate the machine without interference. In large laboratories lines painted on the floor may also be used to indicate major lanes of traffic.

Present and Future Needs. Many schools have planned shops which seemed adequate at the time, only to find them overcrowded almost from the beginning and inadequate after a short period. This indicates that careful attention should be given to determine both maximum present needs and probable future needs. Where large increases in population are anticipated it is well to construct and arrange laboratories in such manner that they can be enlarged and rearranged with a minimum of expense.

"This implies that large equipment should never be so integral with the building that it can not be shifted, that individual drives on all machines are a necessity, and that a number of well distributed service outlets be provided to accommodate semi-portable equipment. It means also that the number and age of the students and the character of future programs must be anticipated, in so far as possible, and equipment planned accordingly."[1]

Number of Work Stations. A student work station in the industrial arts laboratory is broadly defined as any location where the student may be engaged in an activity. These stations would include benches, machines, vises, planning or drawing tables, and tool centers. Some locations should not be included in the total number, as the activity performed may be of short duration or supplementary in nature. Examples

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[1]*Industrial Arts Handbook*—Bulletin 7B—1945, Missouri Public Schools, Jefferson City, Missouri, page 87.

of this type would be the tool grinder, blast furnace, oil stone table, and clamp rack.

In the modern industrial arts laboratory which provides experiences in a great number of activities it is essential that there be many more work stations than students. Recent practices seem to indicate that there should be at least twice as many stations as the maximum number of students using the laboratory at any given time.

School authorities must recognize this problem as they improve and expand their industrial arts program. It would be unsound to suppose that a laboratory which in the past had adequately handled 24 students in woodworking could provide worthwhile activities in a number of areas to the same size group without adding considerably to the number of work stations and total floor area.

Where additional areas have been included in the program without considering this factor, results have not been desirable. It is necessary to stereotype student projects to the extent that little provision is made for individual interests or abilities. The instructor usually becomes a "time and motion" engineer in his efforts to coordinate the work so each student will have something to do and a place to do it.

Use Other than for Regular Classes. The industrial arts laboratory can help fill a real need in providing opportunities for avocational activities through after school and evening classes. These classes might be offered to adults as well as children regularly enrolled in school. If such a program is anticipated consideration should be given to special equipment and materials, lighting, extra storage facilities, and arrangement that will be needed.

Extra curricular activities within the school, such as hobby clubs and stage craft classes, may require special facilities.

In small schools the industrial arts laboratory is sometimes used by the school janitor in connection with school maintenance problems. In some situations this arrangement may be justified, but in general it should not be encouraged. If there is no other solution and the industrial arts laboratory must be used for building maintenance then special provisions should be planned.

Funds Available. Seldom is it possible to secure all the funds desired for housing and equipment. Budgets will be limited and much discrimination must be employed in planning and in equipment selection.

It is sometimes necessary to extend the purchases of equipment over a period of several years. Initial purchases will require careful selection of the most basic equipment. Generally, hand and bench tools should be considered first and machines added later.

Considerable saving can be effected by making some of the benches, cabinets, and storage equipment in the laboratory. Some boards of education find they can make a substantial saving by employing their industrial arts teacher during the summer months to build needed equipment.

Maintenance. Provision for the efficient clean-up and maintenance of the laboratory is an important consideration. Some suggestions might include:

(1) Equipment, machines, and benches with closed bases, flush with the floor.
(2) Horizontal surfaces and open shelves reduced to a minimum.
(3) Book cases with glass doors.
(4) Dust covers for metal lathes and other precision machines when not in use.
(5) Dust collecting systems, either central or individual, for such machines as the sander, table saw, band saw, and surfacer.
(6) Provision for scrap and waste material.

In general many problems even outside the area of maintenance will be solved if a specific position holder rack or shelf be provided for each piece of equipment and item of material and supply included in the industrial arts facility.

2. ARCHITECTURAL CONSIDERATIONS

Floors. Factors to be considered in the selection of suitable floors include safety, durability, sound transmission and light reflection. Wooden floors, either maple or "block on end," are desirable for all areas except those involved in hot metal work. Rubber tile or linoleum is very desirable in the planning and drawing areas. In the hot metals areas concrete is most suitable. However, wooden floors covered with "zonolite," "marflex," or "transite" board are also considered satisfactory.

The floor of the operating position of some of the more hazardous machines should be covered with rubber matting or other non-skid material.

Walls and Ceilings. The walls of the industrial arts laboratory may be wainscoted to a height of about four feet with a durable material that is easily cleaned. Most satisfactory of these materials are mat-glazed brick or tile. However, when modernizing an old building, it may be necessary to use "vitralite," "masonite," or "prestwood," with asbestos board or other fireproof materials in the hot metals area. The remainder of the wall and the ceiling should be finished with an acoustical plaster. "Celotex," "quitile," or "new wood" may be used, although they are somewhat more difficult to maintain. Ceilings should be at least 12 feet high.

Partitions. Some partitions are desirable to separate office space, planning, drawing, and finishing areas. They should be made of wood or steel of the non-bearing type and glazed from a height of approximately 42 inches to the ceiling.

Natural Lighting. Natural lighting is the most desirable type. Windows placed 40 to 48 inches above the floor and extending to the ceiling will provide adequate natural lighting if the room width and ceiling height have the correct proportions. The ceiling height should be equal to one-half the width of the room when windows are located in only one wall. It is desirable for the total glass area to equal at least one-fourth of the floor area.

Equipment involved in precision processes should be arranged so that full advantage may be taken of natural light. The direction of the light source is important in determining the arrangement of most machines.

Natural light is probably best controlled through the use of Venetian blinds of light color and flat finish.

Artificial Light. Artificial lighting should supplement natural light and also provide sufficient lighting in itself if the laboratory is to be used at night.

An intensity of 20 foot candles at bench height is considered satisfactory with individual light sources on machines and surfaces where precision work is done.

Also important is the matter of *diffusion* and *direction.* The surface of radiation of the lighting fixture should provide a

maximum of diffusion. Indirect lighting fixtures are usually most satisfactory in this respect. Adequate shades should be provided for individual light sources located on machines.

Factors other than the light source need to be given consideration. Some of these may include finish on desks, floors, walls, ceilings, blackboard areas, and trim. When a major change in the lighting arrangement is planned a specialist in the field should be consulted.

Color. Consideration of color treatment in the industrial arts laboratory can be made from the standpoint of the environment created as well as from the point of aid to maintenance. In the past, color choice has been based on the latter, resulting in drab shades of cream, brown, and gray.

Numerous studies have shown that the proper selection of colors can aid the student in doing better work with less mental and physical strain. Persons involved in planning the industrial arts laboratory should give careful consideration to this matter. Valuable suggestions and information can be secured from manufacturers of finishing materials.

"Recent developments in the field of synthetic resins have made possible finishes that possess excellent color retention, durability, heat resistance, and a soft sheen effect. Various colors have also been developed for walls, ceiling, machines, and working surfaces that will diffuse light and produce maximum quality and quantity of illumination."[2]

A suggested color scheme might include the following:

Ceiling	—Cascard Blue or Stratosphere Gray (reflective factor 75-85 per cent).
Side walls	—Eye-rest Green (reflective factor 50-60 per cent).
End walls	—Sun tone.
Floors	—Gray with orange stripes for safety zones and traffic lanes.
Machines	—Vista green, with danger points, controls, and moving parts in focal colors of yellow, red, or orange.
Tool panels, cabinets, etc.	—Rose tan or Sand.

Acoustical Treatment. Excessive noise reduces efficiency of both students and teacher and is undesirable from the standpoint of physical and mental health. The control of noise both

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[2]Joseph C. Thompson—"Color in the School Shop," *Industrial Arts and Vocational Education Magazine*, pp. 98-101, Bruce Publishing Company, Milwaukee, Wisconsin, March, 1947.

in the laboratory and its transmission to other parts of the building must be considered.

The source of excessive noise should be minimized if possible. This will involve the selection of well designed machinery mounted on adequate bases. Equipment such as anvils, stake plates, and machinist vises will require heavy benches and mountings.

The transmission of noise can be prevented through the use of sound absorbing materials covering the walls and ceilings. Machines should never be mounted on columns or structural members of the building. Some machines may require rubber, felt, or composition materials between their mounting and the floor. A layer of builder's felt between the sub-floor and the finished floor will aid in this problem.

3. AREAS OF ACTIVITY

Planning and Drawing. All activities in the industrial arts laboratory tend to revolve around this area. Therefore, it should be centrally located if possible. Glazed partitions separating it from the noise and dust of other areas are desirable.

Planning activities usually include reading, sketching, drawing, tracing, preparing bills of materials, listing sequence of operations, studying informational material and research. Equipment needed to carry on these activities will include tables, chairs, files, cabinets, book cases, and magazine racks, drawing tables and stools, charts, display shelves, enlarging and duplicating devices, and other drawing equipment.

Woods Area. The machines and hand woodworking areas should be adjacent and include supplementary areas for gluing, assembling and finishing. It is usually desirable to locate the woodworking machines near the lumber room.

Special consideration must be given to dust and waste materials. Minimum requirements include individual dust collectors for the table saw and sander.

Wood benches should be 32 inches high and arranged so that the major light source comes from the left side of the working position. Light direction is also important in determining the position of machines. An example might be the table saw where it is desirable for the major source of light to be from the left of the operator.

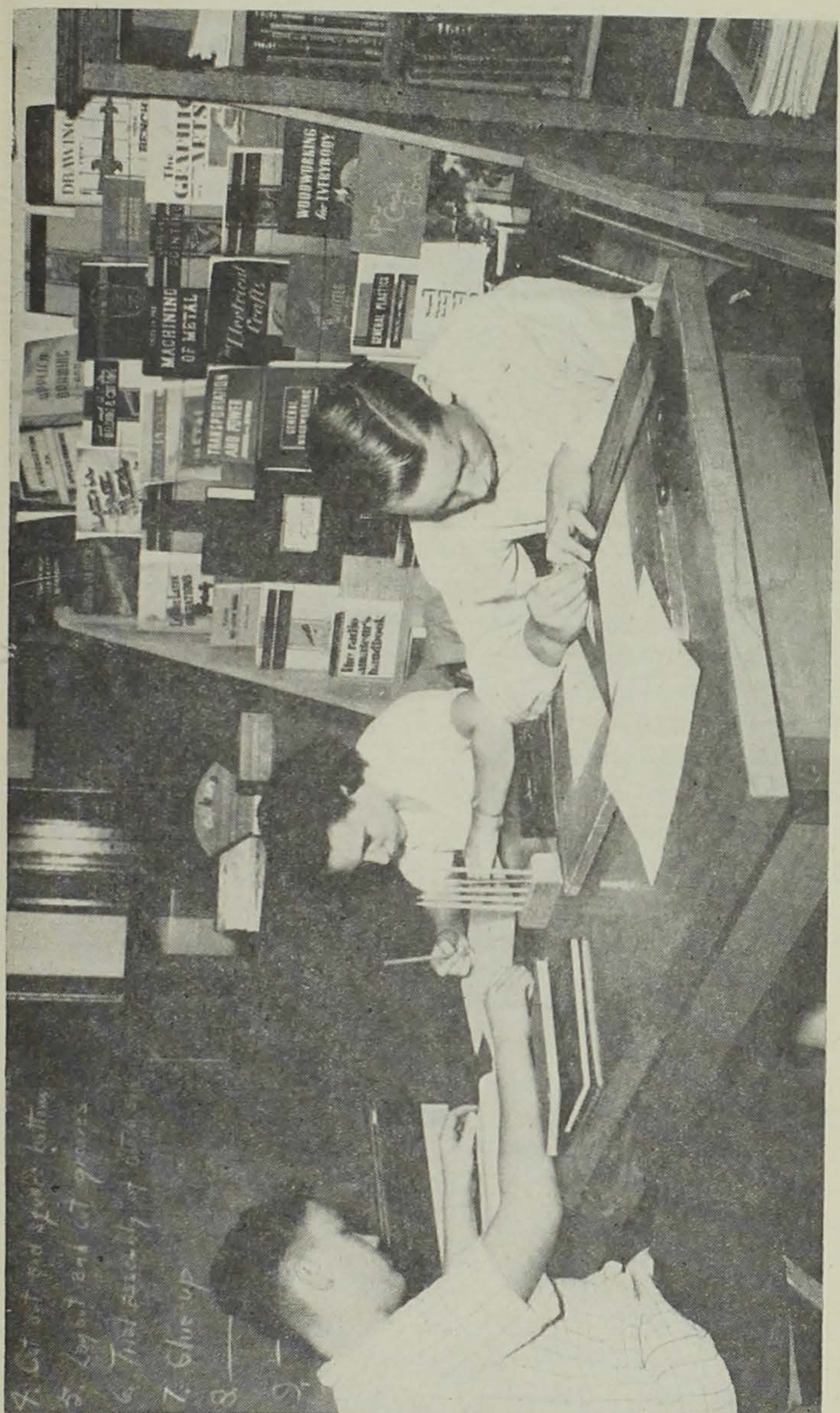


Figure 8. At Work in the Planning Area.

Metals Area. The bench, sheet and art metal area could well be located near the hand woodwork area. Woodworking benches and vises can be used for lay-out, cutting, and some shaping and bending. Hot metal equipment such as that used for forging, foundry, and welding should be grouped together. This will simplify the problem of hooding and gas service. The machine tool area will need the best of lighting, and the location should be relatively free of dust and dirt.

Transportation Area. This area will include auto mechanics and possibly some aircraft mechanics. Other areas in the laboratory will supplement this area. Special equipment may include several types of motor blocks, automobile chassis, sample airframe construction, jacks, hoists, and other maintenance equipment. Trays and drawers or other facilities should be provided for storing disassembled parts between working periods. Most of the motors will probably be "dry." However, if it is planned to operate them, provisions must be made for exhaust gas.

Tools in this area are usually handled through the use of kits and toolboxes.

An outside entrance, large enough for an automobile, is desirable. Sufficient open space should be provided just inside this entrance for washing and servicing. A floor drain should be included.

Electricity Area. The soldering and sheet metal work involved in many electrical projects should be considered when locating these areas. Wall type benches are often used because it is convenient to mount meter panels and provide electrical outlets just above the working surface.

Home and Farm Mechanics. Due to the great variety of work that may be classed under these headings, the entire laboratory can be considered as constituting these areas. The work in farm mechanics may require additional open area where projects in carpentry can be constructed. Many instructors plan for large construction problems in this area during the fall and spring when students can work just outside the drive-in entrance. Well developed areas of wood, metal, and auto mechanics will provide most of the equipment needed. A heavy grinder, if not included in the other areas, should be

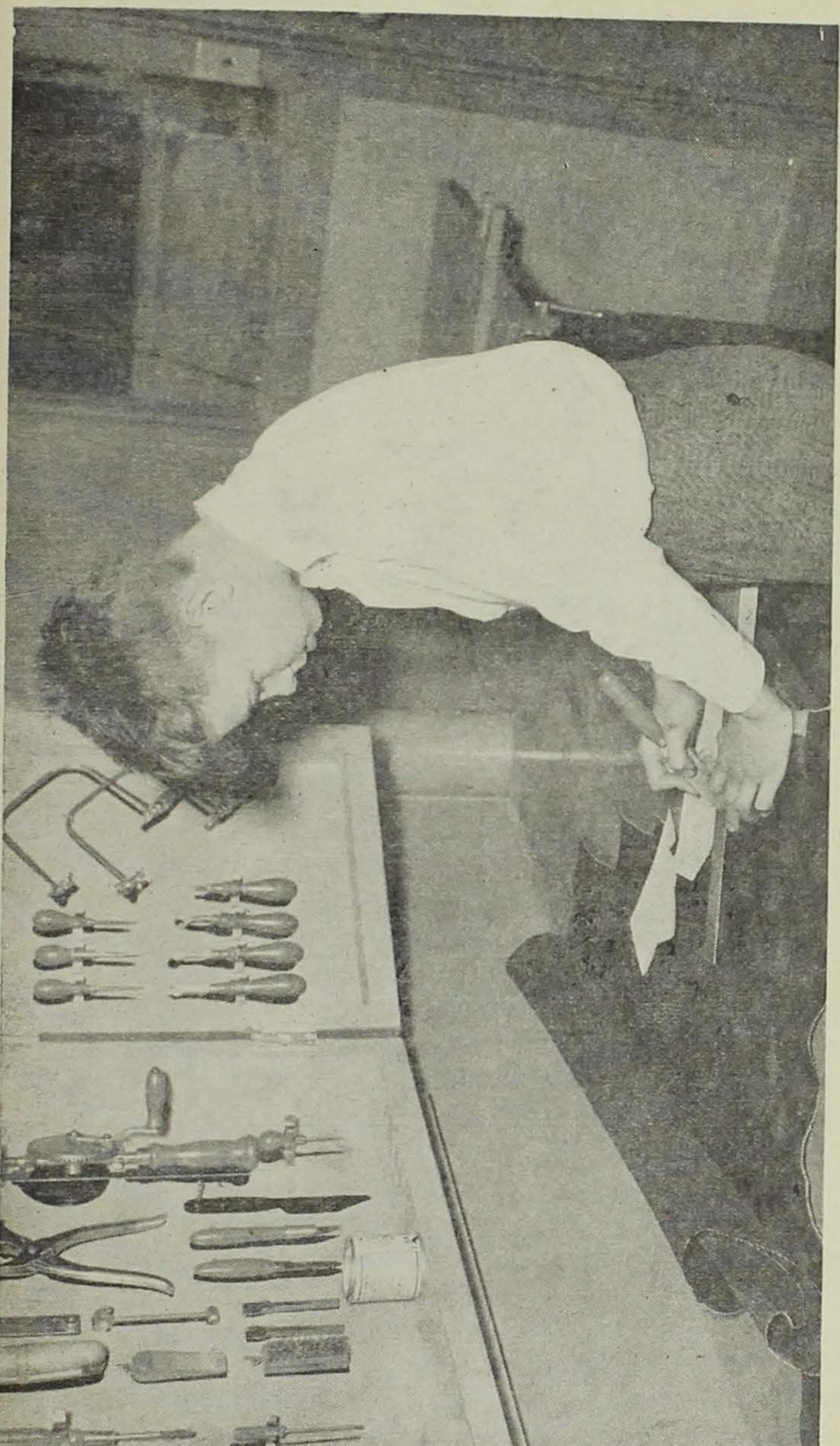


Figure 9. Leather Work in the Crafts Area.

added. Some special equipment may be needed if harness repair is included.

Crafts. The nature of this work requires that good lighting be provided and that the area be removed in so far as possible from the more noisy and dusty sections. The student will do most of this work while seated, which implies that tables 30 inches high with stools or chairs be provided. Special storage facilities are needed because of the size and cost of many of the materials used.

4. SUPPLEMENTARY AREAS

Instructor's Area. The instructor should have some designated area which would include a desk, filing cabinet, and locker space, preferably removed from noise and dirt, but commanding a full view of the laboratory. In small laboratories it is often desirable to combine this facility with the planning and drawing area.

Material and Supply Storage. Plans should include a general stock room which will provide storage space for lumber, sheet metal, bar stock, and many other materials used in the shop. Racks, shelves, and cabinets should be carefully planned and organized to fit the requirements of the materials to be stored. Sufficient space is usually a problem, and it is desirable to secure an additional bulk storage room in another part of the building that savings may be secured from quantity purchases. Materials from this auxiliary storage room can be placed in the "working stock" in the general storage room as needed. In small stock rooms many have found vertical storage racks desirable for lumber. Provision should be made for scrap and "shorts" storage.

Finishing Room or Area. When possible, it is desirable to have a room, separated from the main laboratory with glass partitions, and well lighted and ventilated. Equipment may include drying shelves, metal top work tables, spray booths, spray equipment, bulk storage cabinet, and finishing material rack. Fireproof containers should be provided for oily and dirty rags. This room should not be used for general project storage, as it invites extra traffic from the laboratory, which results in excessive dust and dirt being carried into this area.

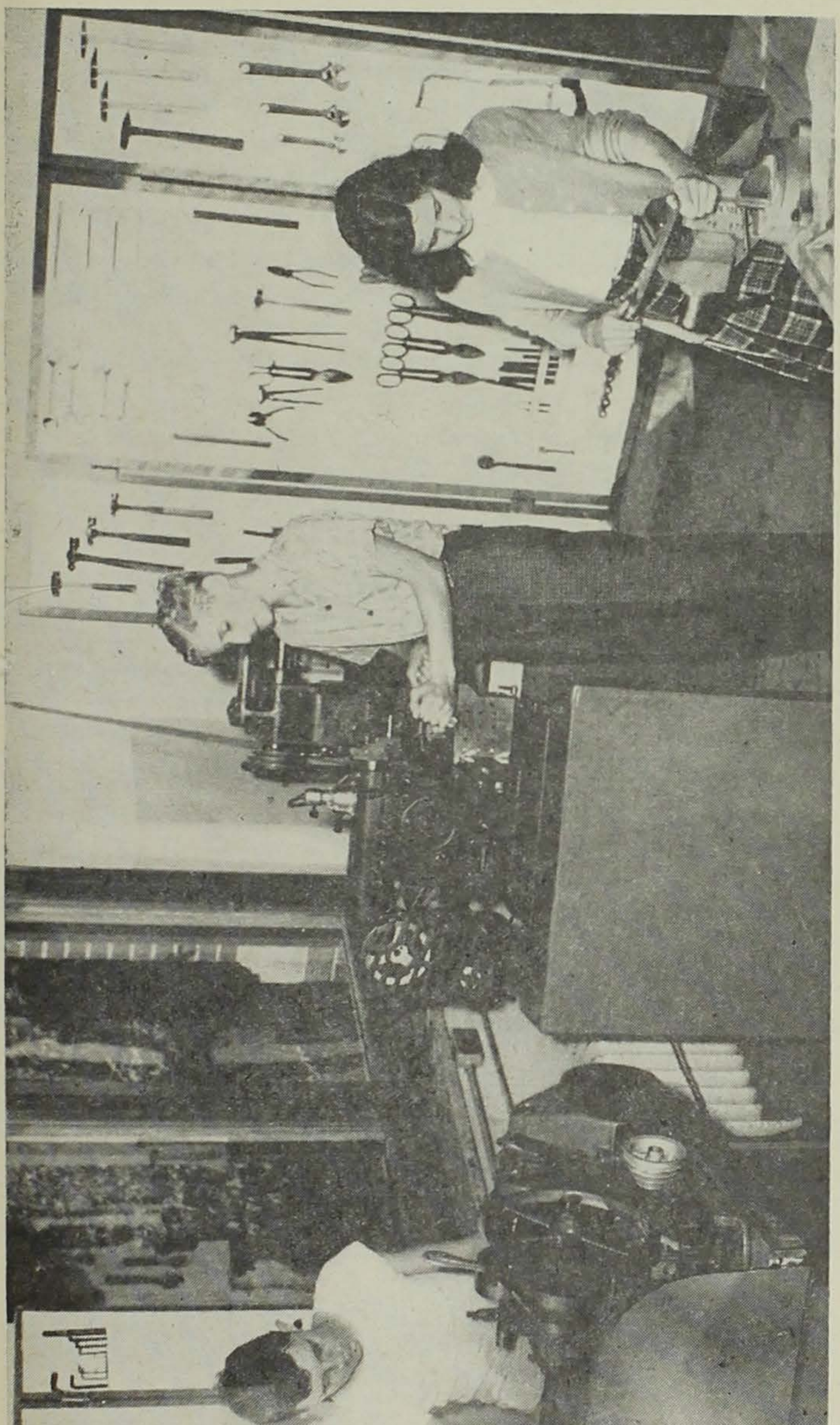


Figure 10. Metals Area.

It may not be possible to establish a separate room for finishing in the small laboratory, and the facility may consist of only a bench, work area, and cabinet. This will necessarily limit the use of varnish and other slow drying finishes. However, there are many lacquers, rubbed and fast drying finishes, that can be used quite successfully under these conditions.

Student Material and Project Storage. Each student enrolled in the industrial arts laboratory needs some drawer or locker space where he may keep his personal property, which may include plans, apron, pencils, and project materials. There must be provision for locking this compartment when the student is not in the laboratory.

Some of the more common devices developed by industrial arts teachers to serve this need include:

(1) Individual lockers or drawers with combination locks.
(2) Individual lockers or drawers with keyed locks. The keys are kept on a panel which is made available to the students during the working period.
(3) Individual drawers or lockers, a number of which can be secured with one lock through the use of a hinged bar and hasp. These are locked and unlocked by the instructor or a student assistant.
(4) Group lockers where three or four students share the same locker space. The locking devices may be any of the previous mentioned.
(5) Class storage lockers may consist of a large space shared by an entire class and open when that particular class is in session. This provision is desirable, in addition to individual lockers, for the storage of large and bulky materials.

In some schools it may be possible to use hall lockers providing those near the laboratory are assigned to industrial arts students.

It may seem that too much stress is placed on this particular problem. However, the instructor must understand that although the project or student work may seem almost worthless, as judged by adult standards, it may be of great value and importance to the student and would affect him greatly if it were stolen, lost, or misplaced.

The location of the student locker area must be given careful consideration to avoid overcrowding and excess traffic at the beginning and end of the work period.

Tool Control. The use of localized tool panels seems to fill the need most adequately for the industrial arts laboratory where a number of areas are represented. This plan requires a tool panel for each general area represented, usually mounted on a wall adjacent to the area served. These panels require careful planning. The design should include some method of locking or otherwise securing the tools.

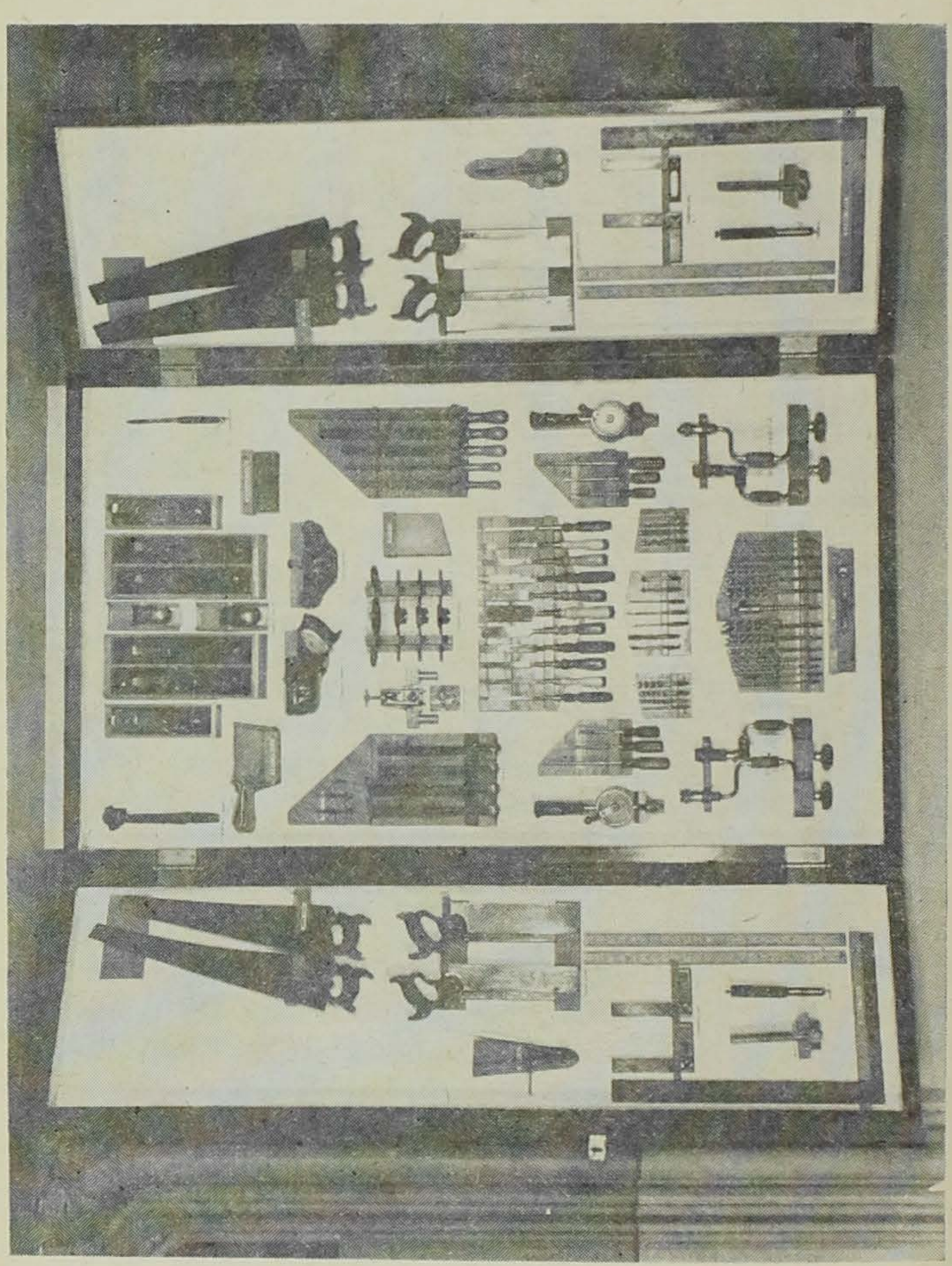
Well designed tool holders, such as those shown in Figure 11, should be developed. They should include some of the following features:

(1) Holds tool in one position. Preferably this position should be secured without having to revolve or change natural holding points.
(2) Holds tools securely and protects them from damage. Also protects student.
(3) Made of hard wood or metal to withstand wear.
(4) Easily cleaned and maintained.
(5) Attached to tool panel with screws to facilitate replacement or rearrangement.
(6) Includes silhouette, name and size of tool.

Tool panel arrangements should be considered as to appearance, usability, and safety. For example, tools may be arranged in a symmetrical or interesting pattern and also grouped in relation to their uses. Pointed and edged tools should not be hung above eye level. The panel and holders should be carefully finished in natural shades or with enamels.

Display. Facilities for exhibiting student work, industrial materials and products, and various visual aids are an important part of the industrial arts laboratory. Cabinets built into the wall and facing the corridor outside of the laboratory are desirable, as they make the display available to all students in the school. It is usually necessary to provide some means of artificial lighting for these corridor cases or cabinets.

Cabinets, cases, shelves, and bulletin boards that can be used for display purposes should be included inside the laboratory in connection with the planning center. Some should be glass enclosed to protect the exhibited materials from dust and excess handling.



5. SERVICE FEATURES

Utilities. Gas, water, and electricity should be thought of as essential utilities for every industrial arts laboratory. Compressed air is often included in this list. A general distribution of outlets, especially those for electricity, should be provided.

Washing Facilities. A sufficient number of sinks should be provided to allow one washing position for every 10 students. Highly desirable, particularly in the larger laboratory, is the industrial-type wash fountain. One deep sink piped with hot and cold water and with a clay trap is needed for ceramics, brush cleaning, gluing, quenching, and other uses.

Drinking Fountains. It is very desirable to have a drinking fountain in the laboratory. This may be provided in connection with the washing facility.

Toilet Facilities. These should be provided in connection with the shop or at least near by.

Heating and Ventilating. The ventilating system should be separate from that of the rest of the building. All excessive heat and fumes can be cared for by ventilating the areas involved by means of hoods and exhaust systems. Flues must be provided through which all gases can be carried to the roof. A separate flue for the finishing areas is necessary. Allowance must be made for heating units as the equipment arrangements are planned.

Minimum requirements suggest 6 to 7½ changes of air per hour at 65 degrees F. temperature, with relative humidity of 30 to 60 per cent.

Bulletin Boards and Blackboards. The blackboard is a valuable teaching aid. One should be included in the planning and drawing area, with its position determined through study of the lighting, student position, and desk or table height. Many instructors like to have a portable blackboard that can be easily moved to any area in the laboratory.

One large bulletin board located near the main entrance to the laboratory is needed for general announcements, assignments, and display. Smaller boards located in the various areas of activity are valuable for posting detailed instruction and information. They should be made of standard materials and well lighted.

First Aid Kit. One well-equipped unit should be conveniently located. Standard kits can be secured through the American Red Cross. The minimum equipment would include a needle, tweezers, antiseptic, assorted band-aids and compresses, adhesive tape, gauze, and a tube of tannic acid jelly.

Fire Extinguishers. A must for the industrial arts laboratory. They should be located in the more hazardous areas and serviced regularly with other units throughout the building.

6. REMODELING AND REARRANGING

Relatively few industrial arts instructors will have the opportunity to plan the layout, equip, and organize the industrial arts department in a new building. For most instructors it will be a problem of rearrangement, rebuilding, repainting, and reorganizing an old shop or laboratory. The location, size, shape, and proportions of the rooms are fixed and cannot be altered. The problem becomes that of making the best of the situation with the fixed limits.

Many of the basic principles involved in planning and equipping can be applied to an old room or group of rooms with satisfactory results. Some of the possibilities are:

(1) The changing of artificial lighting.
(2) The rearrangement of workplaces.
(3) The cutting of new window openings and new doors.
(4) The building of new partitions for auxiliary rooms.
(5) The painting of walls and ceilings so as to add to the appearance of rooms and the improvement of the light.
(6) The reconditioning of floors.[3]

To this list could be added such details as tool and supply storage, bulletin boards, blackboards, display cabinets, electrical outlets, gas outlets, student material storage lockers, instruction materials storage, and many others. Developing these facilities in such a way that the laboratory will provide the maximum in teaching efficiency, safety, and attractiveness should be the goal.

Whether the planning involves a new building or the improvement and expansion of an existing laboratory, the following procedure may be helpful:

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[3]Arthur B. Mays, and Carl H. Casberg, *School-Shop Administration*, Bruce Publishing Company, Milwaukee, Wisconsin, 1943, page 30.

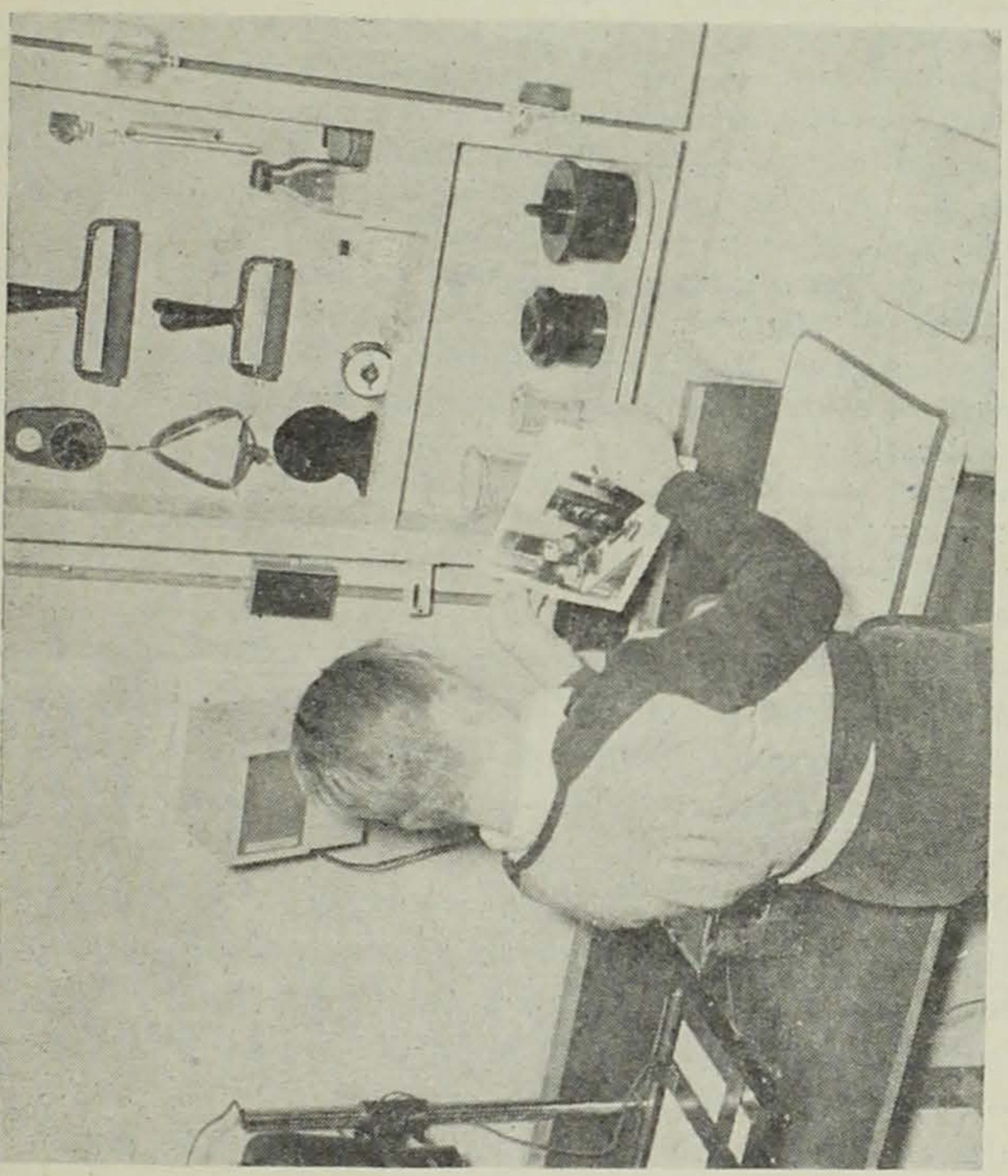


Figure 12. Photography.

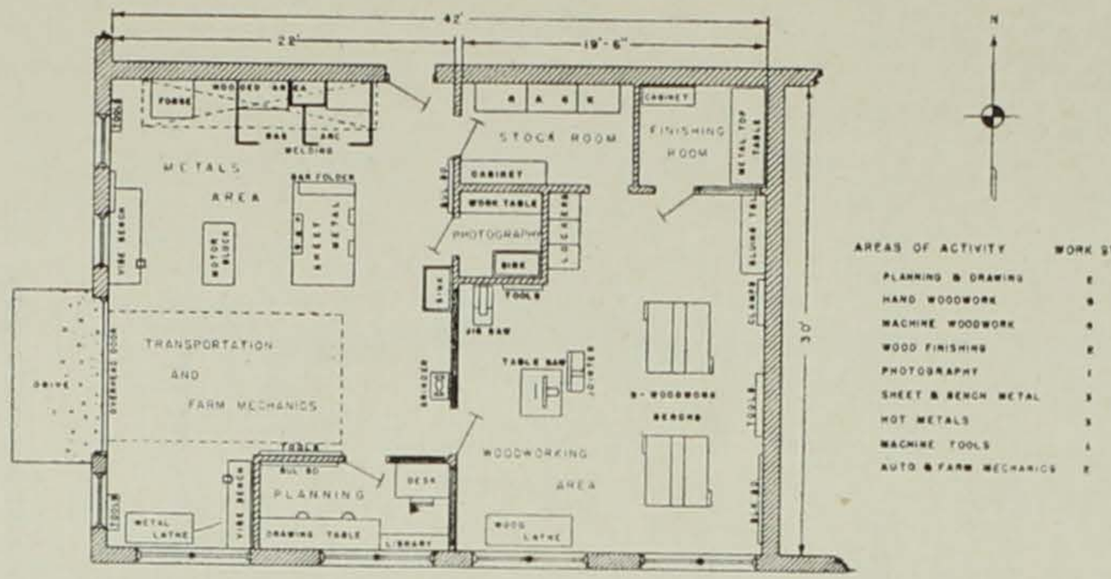
1. Study needs and possible changes.
2. Make a scale drawing (usually ¼″ = 1′ — 0″) showing walls, partitions, windows, doors, and heating units of existing or proposed building.
3. Determine the best location for the areas of activities to be included. This may alter the position of partitions if they can be moved.
4. Cut out card board templates of the tables, benches, machines, cabinets, racks and other equipment needed. These templates need not be elaborate. Rectangles or circles the size of the floor area used by the equipment is satisfactory. They must, of course, be of the same scale as the drawing.
5. Place these templates on the floor plan and move them into the various possible arrangements. Consider the factors previously presented in this chapter. Try to visualize a class at work. Consider the space around the work stations, sequence of operations, traffic lanes, clean-up procedures, etc.
6. When the best arrangement has been secured, draw this arrangement on the floor plan.
7. Make a finished tracing of the drawing. Include information in regard to lighting, heating, plumbing, and other architectural considerations.
8. Blueprints should be made. These will be valuable in informing the various school authorities of the program planned.
9. Develop detailed equipment lists, complete with specifications and cost.

In small schools where funds are limited it is often advisable to secure help from the students in the changes and development of the program. Some of the remodeling projects can become teaching projects. This procedure requires additional thought and planning.

Figures 13 through 16 show some suggested layout schemes for industrial arts laboratories in small, medium, and large-sized high schools, as indicated by their title. These are actual situations in Iowa and although not ideal in all respects, they do represent good planning practice.

Figure 14 presents a medium-sized laboratory which has been enlarged to include a room across a corridor. It would have been more desirable to have had this room adjacent to the main laboratory with glass partitions between. This, however, was not possible, and the arrangement shown has been found to be satisfactory.

Figure 16 shows a large laboratory. The planning and drawing area is small. Additional provision for drawing is secured by a special board-holding device used on the woodwork benches adjacent to the planning and drawing room.



A SMALL

INDUSTRIAL ARTS LABORATORY

RECOMMENDED CLASS SIZE - 10

NUMBER OF WORK STATIONS - 23

TOTAL FLOOR AREA - 1220 SQ. FT.

Figure 13. A Small Industrial Arts Laboratory.

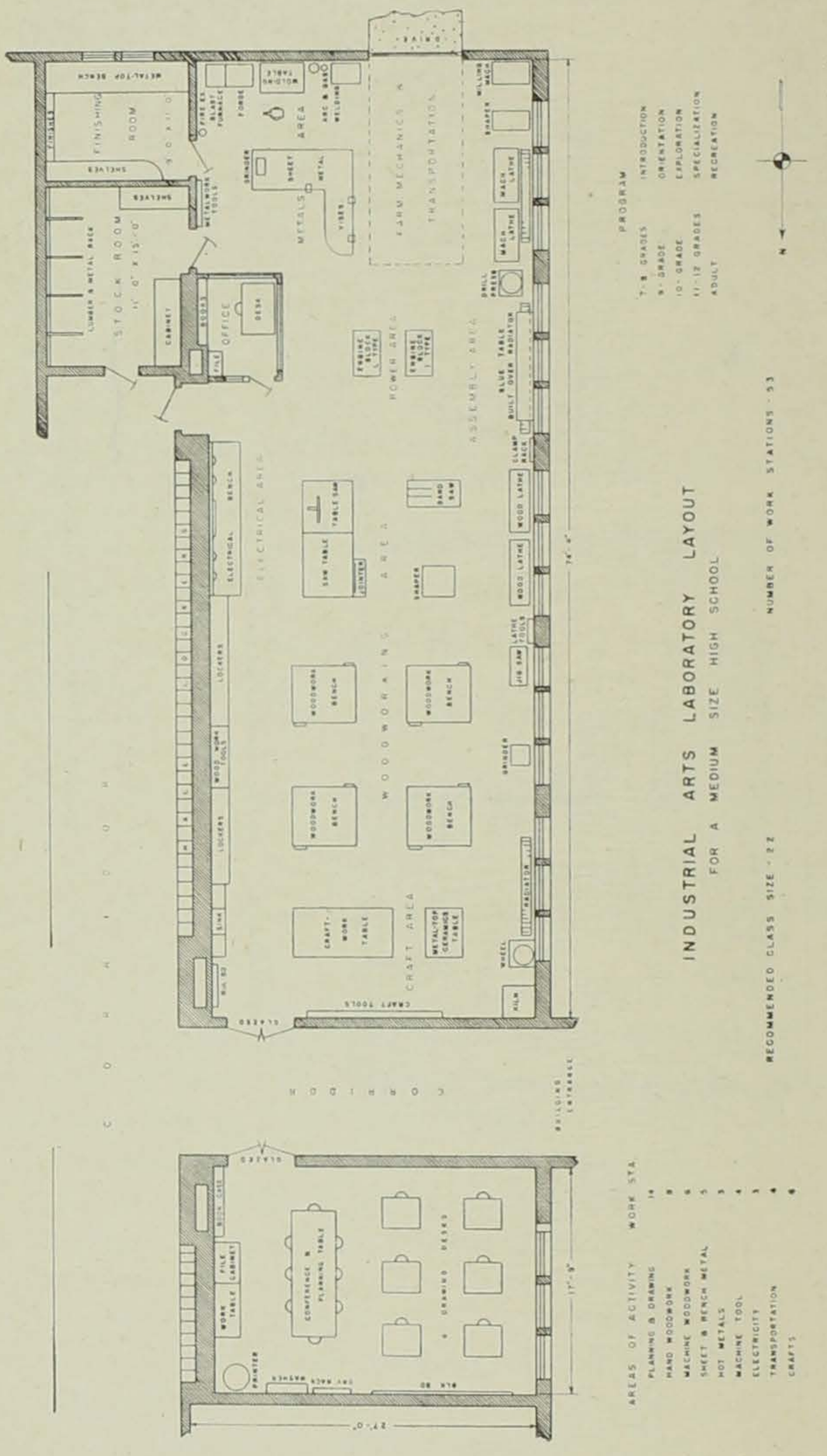


Figure 14. A Medium-sized Industrial Arts Laboratory.

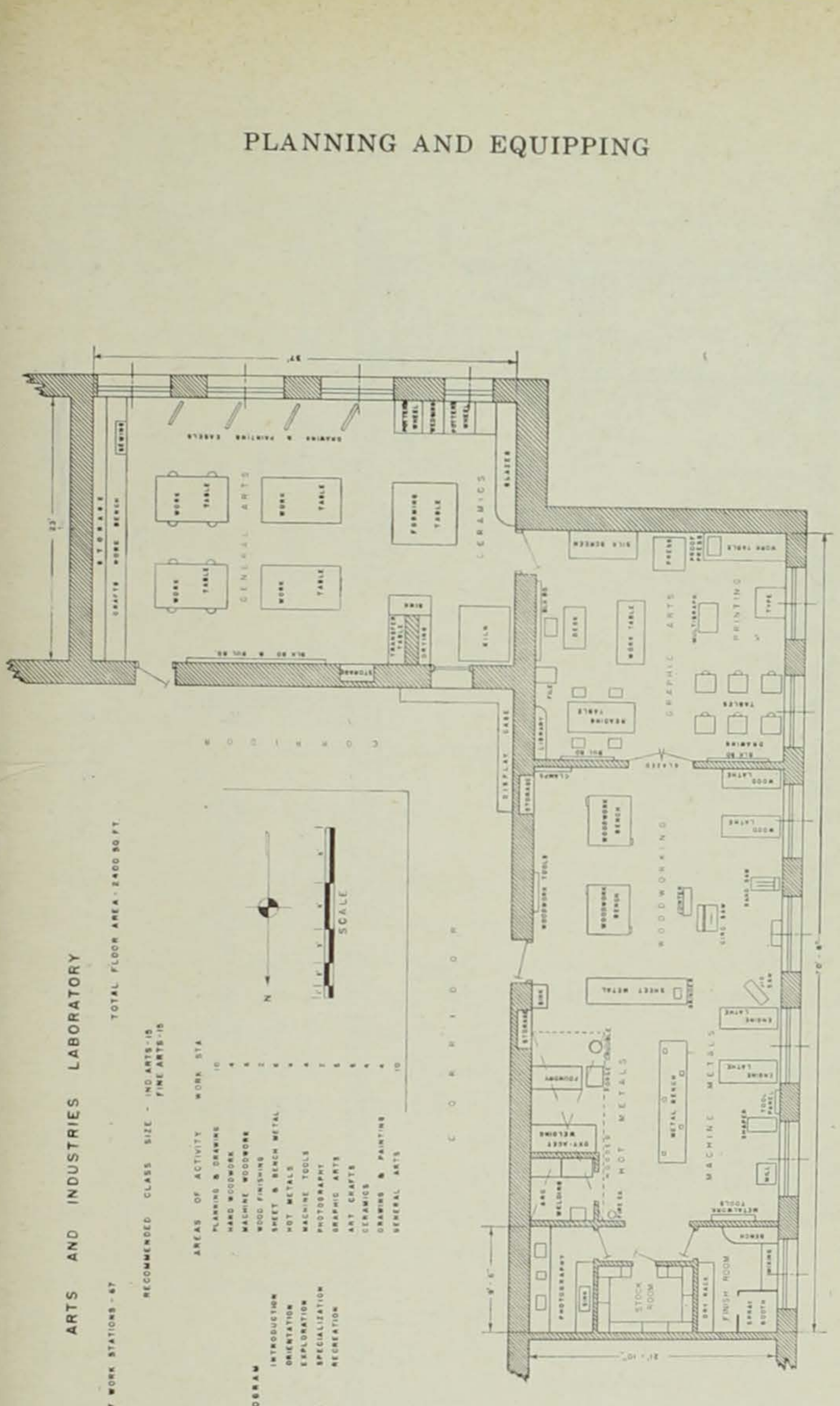


Figure 15. A Medium-sized Arts and Industries Laboratory.

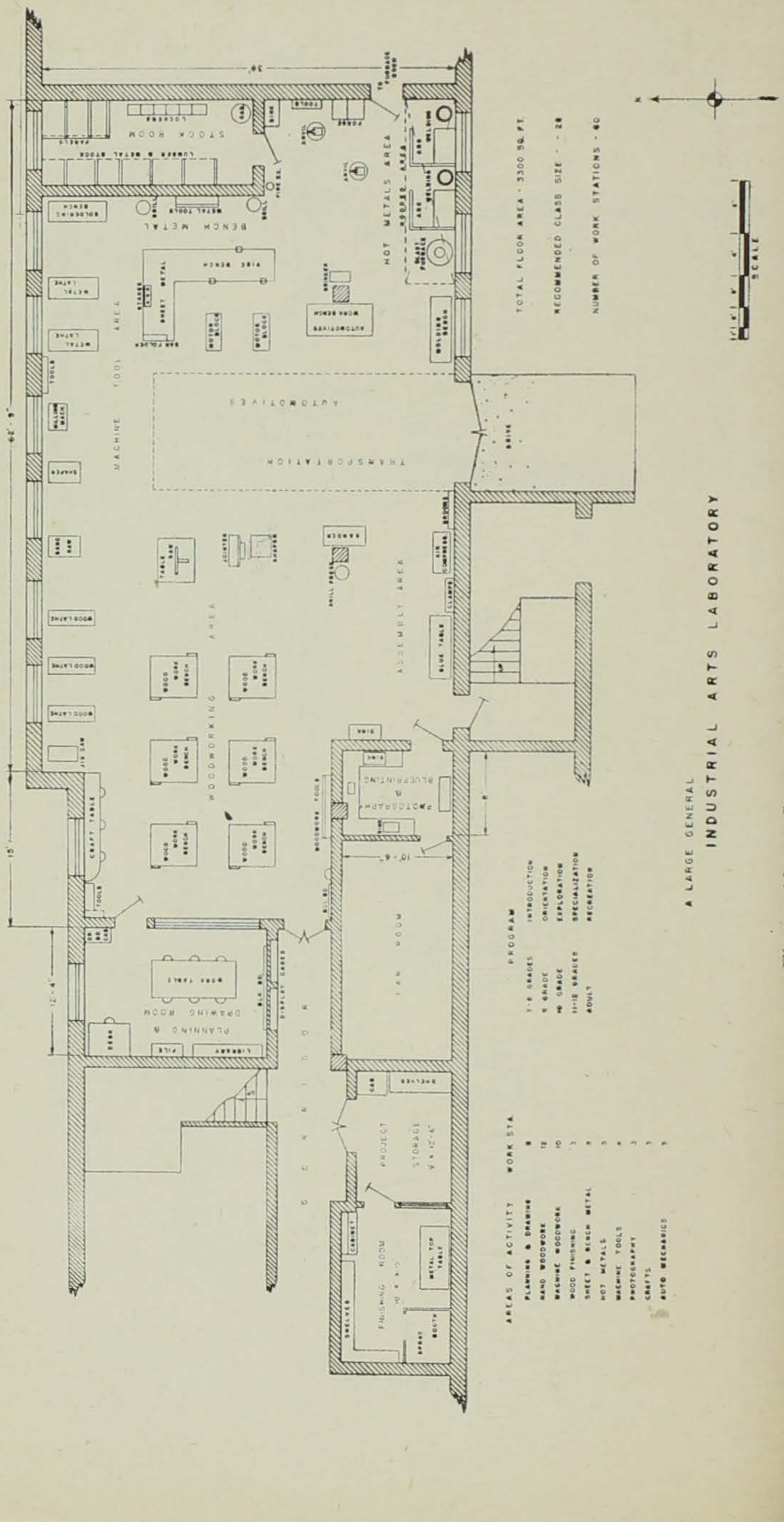


Figure 16. A Large Industrial Arts Laboratory.

The finishing room is illuminated with artificial lights. Natural light is more desirable.

7. SELECTION OF EQUIPMENT

The great variety of tools and equipment needed in the modern industrial arts laboratory presents a problem that involves careful planning, budgeting, and purchasing in its solution.

Basic Factors. Intelligent listing and selection of equipment cannot be accomplished until the following items are clearly defined:

1. The areas of activities to be included.
2. Content and scope of the program.
3. Maturity of the student.
4. Size and location of the laboratory.
5. Size of classes.
6. Future plans for the program.
7. Funds available.

Making Lists. It is usually desirable to first develop an ideal list of equipment with regard to all of the above factors except the last. Budget limitations can then be considered and deletions made without fear of overlooking some essential item. It may be necessary to extend the purchase of the complete list over a period of several years. This will require careful study and planning to determine what equipment should be secured first.

The suggested equipment lists that are included in this chapter should be helpful. Catalogues from manufacturers and distributors should be secured and studied. Professional magazines in the industrial arts field present many equipment lists.

Selection of Types and Makes. The problem of determining the specific makes, sizes, and qualities is not easy. Some of the factors to be considered in this matter would include:

1. Reputation of the firm.
2. Ability to deliver.
3. Guarantee and service.
4. Provision for repairs and adjustments.
5. Pleasing design.
6. Attractive and durable finish.
7. Safety features.

Hand or Power Tools. "In the introduction of industrial arts work, hand tools are generally regarded as being of more importance than power tools. This is especially true where finances do not permit an elaborate or complete outlay of equipment. A given sum spent for hand tools will go much farther than if spent for power tools, and the tools thus secured will provide for both a larger number of students and a wider spread of activities. Power tools, however, increase and enlarge the scope of the work that can be done, but they also increase the hazards."[4]

In recent years many power tools that are well designed, efficient, and quite satisfactory for instructional purposes, have been made available. Costs have been low enough that even small schools have been able to include some of them in their industrial arts program.

Combination Machines. There are available today many combination machines. Examples would include: a saw and jointer mounted on one table and operated by a common motor; drill presses that could be made to serve as a shaper, router, mortiser, planer, and sander. These combinations are quite desirable and advantageous in the home workshop where they are operated by one person. In the industrial arts laboratory, however, their value is questionable. Much time would be wasted in making and changing set-ups, and several students working so close together would be unsafe.

Unit machines individually mounted and powered should be considered as most desirable for the school situation.

Safety Features. When selecting equipment, safety features should be continually checked. Some of these would include:

1. Guards.
2. Enclosed pulleys and belts.
3. Over-load circuit breakers.
4. Vibration eliminated.
5. Positive and efficient controls.
6. Individual lighting.
7. Dust collecting system.
8. Desirable operating heights and positions.

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[4]*Industrial Arts Handbook*—Bulletin 7B, 1945, Missouri Public Schools, Jefferson City, Missouri, page 94.

8. EQUIPMENT LISTS

The following lists are presented as the necessary equipment for an adequate program in the "one-teacher" industrial arts laboratory, offering work in several areas of activity.

The approximate number of each item needed in a small, medium, and large situation is indicated. The small laboratory is defined as one equipped to handle 10 students or less; the medium, 10 to 20 students; and the large, 20 to 30 students. The amount of equipment is based on the principle that in a laboratory where a number of activities are in progress, all under the direction of one instructor, it is necessary to provide at least twice as many work stations as the number of students enrolled in the largest class.

A separate and complete listing is presented for each area except that of "home and farm mechanics." This area requires much of the same equipment as that used in wood, metal, and electricity. Therefore, only the additional items needed in this area are listed.

Prices have not been included because of their unstable condition at the present time. A few items are described more completely by giving brand and number. This is done merely to indicate quality, and other brands of equal specifications would be as desirable.

PLANNING AND DRAWING AREA

	Small	Medium	Large
Furniture			
Bookcase	1	1	1
Cabinet—for storing drawing equipment	1	1	1
Chairs—for planning and conference table	3	4	8
Desk and chair (Instructor's)	1	1	1
Drawing stools	3	6	9
Drawing tables	3	6	9
Filing cabinet	1	1	1
Planning table	1	1	2
Supply cabinet	1	1	1
Equipment			
Architect's scales 12 inches hardwood	4	8	12
B & W developing machine			1
Blue print washing vat	1	1	1
Blackboard compass		1	1
Drawing boards, 16 by 21 inches basswood	3	6	9
Drawing boards, 20 by 24 inches basswood	3	6	9

PLANNING AND DRAWING AREA (Cont.)

	Small	Medium	Large
Equipment (Cont.)			
Drawing instruments, set (complete with 3 bow instruments)	4	8	12
Erasing shield	1	2	3
French curves 8 inches (assorted)	2	4	6
Master bow compass, 5½ inches—Dietzgen	3	6	9
Pantograph, hardwood bars	1	1	1
Paper knife—board, 24 by 24 inches		1	1
Pencil sharpener (regular)	1	1	2
Pencil sharpener (draftsman)	1	1	1
Printing frame (sun)	1		
Printing machine		1	1
Protractor, semi-circular 5 inches	1	2	3
Tracing box (lighted glass top)		1	1
Triangles 30-60 degrees 10 inches celluloid	4	8	12
Triangles, 45 degrees 8 inches celluloid	4	8	12
T-squares 21 inches—hardwood, fixed head	3	6	9
T-Squares 24 inches—hardwood, fixed head	1	2	3

WOODWORKING AREA

Machine and Benches			
Band saw 16 inches, complete with motor and cast iron base		1	1
Bench, gluing bench or table, clamp storage below	1	1	1
Bench, wood finishing, metal top, cabinet below	1	1	1
Benches, woodworking, maple top, complete with vises, student storage lockers, or drawers in base	2 dbl	4 dbl	6 dbl
Drill press, floor model complete with motor, mortising attachments and Jacobs chuck		1	1
Grinder, pedestal type, with safety flanges and eye shields	1	1	1
Jig saw, direct motor or belt driven, complete	1	1	1
Jointer 6 or 8 inches, table fitted for rabbeting. Safety cylinder type, complete with guard and motor	1	1	1
Lathe, wood turning, complete with motor switch, tool rest, centers, and face plates	1	2	3
Router-shaper, Stanley, with cutters		1	1
Sander, portable, hand plane type, Porter-Cable			1
Spray gun—complete with hose, nozzles, and air compressor			1
Table saw 10 inches complete with motor, guard, fences, and blades	1	1	1
Tool panel	1	1	1

WOODWORKING AREA (Cont.)

	Small	Medium	Large
Hand Tools			
Awl, brad	1	1	2
Bevel, sliding-T	1	1	2
Bits, auger, ¼ to 1 inch by 16ths (set)	1	1	2
Bits, auger, ¼ to ½ inch by 16ths	1 ea	1 ea	1 ea
Bits, counter sink, rose pattern, sizes ½, ⅝, ¾ inch	1 ea	1 ea	1 ea
Bits, forstner, ¼ to ½ inch by 16ths		1 set	1 set
Bits, dowel, ¼, 5/16, ⅜ inch		1 set	1 set
Bits, screwdriver, ¼, 5/16, ⅜ inch	1 ea	1 ea	1 ea
Bits, expansive	1	1	1
Bits, wood boring twist, ⅛ to ⅜ inch by 16ths	1 set	1 set	1 set
Braces, 8 inches, Stanley ratchet types	1	2	3
Braces, 10 inches, Stanley ratchet type	1	1	1
Brushes, bench 10 inches	4	6	12
Brushes, glue, round ¾ and 1½ inches		1 ea	1 ea
Burnisher	1	1	1
Calipers, 8 inches outside (solid nut)	1	2	3
Calipers, 6 inches inside (solid nut)	1	1	1
Carving tools—6-tool set	1	1	2
Chisels, socket firmer, ⅛, 1, ⅝, 1½ inches	1 ea	1 ea	1 ea
Chisels, socket firmer, ¼, ⅜, ½, ¾ inch	1 ea	2 ea	3 ea
Chisels, wood turning sets	1	2	3
Parting tool ⅛ inch			
Round nose, ¼, ½ inch			
Spear point ½ inch			
Gouges ½, ¾ inch			
Skews ½, 1 inch			
Clamps, "C" 4-inch opening malleable iron	2	4	6
Clamps, "C" 6-inch opening malleable iron	1	2	3
Clamps, "I" bar 36 inches	4	6	8
Clamps, "I" bar 48 inches	2	2	4
Clamps, "Jorgensen" hand screws 8 inches	4	6	8
Clamps, "Jorgensen" hand screws 10 inches	2	2	4
Dividers, 8 inches	1	1	2
Doweling jig, with bushings		1	1
Drill bits, twist, straight shank, 1/16 to ⅜ inch by 32nds	1 set	1 set	1 set
Drill hand, ⅜ inch chuck	1	1	2
File, auger bit	1	2	2
Files, cabinet, round and half-round 10 inches	1 ea	2 ea	2 ea
Files, saw, 7 inches, extra slim taper and slim taper	2 ea	2 ea	3 ea
Fire extinguisher	1	1	2
First aid cabinet and supplies	1	1	1
Gauges, marking	2	3	4

WOODWORKING AREA (Cont.)

	Small	Medium	Large
Hand Tools (Cont.)			
Glue pot, electric thermostatic control		1	1
Gouges, outside ground, ¼, ½, ¾ inch	1 ea	1 ea	2 ea
Hammers, nail, 13, 10, 7 ounces	1 ea	2 ea	2 ea
Hammer, upholstery magnetic, 7 ounces	1	1	2
Knife, putty	1	1	2
Knife, sloyd, 3-inch blade	2	3	4
Level, 24 inches	1	1	1
Miter box—Stanley No. 150	1		
Miter box—Stanley No. 224		1	1
Mallet, wood, barrel-shaped head	2	3	4
Nail sets, 2/32, 3/32, 4/32	1 ea	2 ea	2 ea
Oilers, bench ⅓ pint coppered	1	2	2
Oil stones, 1 by 2 by 8 inches—combination	1	2	2
Oil stones, gouge slip, medium grade	1	1	1
Oil stones, slip, medium	1	2	3
Plane, router, with cutters		1	1
Plane, smooth, 9 inches, 2-inch cutter	1	2	2
Plane, duplex rabbet, Stanley No. 78			1
Plane, fore, 18-inch bed, 2⅜-inch cutter		1	1
Planes, block, Stanley "Boy-Proof"	1	2	3
Planes, jack, 14 inches, Stanley No. 5, 2-inch cutter	2	4	6
Pliers, combination, 6 inches	1	2	2
Rule, board, "Lufkin" No. 10 (measures 7 to 16 feet lengths)		1	1
Rules, bench, maple, 2 feet graduated in ⅛ths and 1/16ths brass capped	2	4	6
Saw, compass—10 inches	1	1	1
Saw-filing clamp	1	1	1
Saw, keyhole—10 inches, 10 points	1	1	1
Saw set, pistol grip, adjustable	1	1	1
Saws, crosscut, skew back, 22-inch blade, 9 points	1	2	3
Saws, rip, 22-inch blade, 7 points	1	1	2
Saws, back, 14 inches	1	1	2
Saws, back, 12 inches	1	2	3
Saws, coping	2	4	6
Saw, miter box, Disston No. 4, 26 inches	1	1	1
Scraper, swanneck—3 by 5 inches	1	1	1
Scraper, cabinet—double handle	1	1	2
Scrapers, hand, 3 by 6 inches	2	3	4
Screwdriver, automatic, with bits			1
Screwdrivers, 4 inches	1	2	3
Screwdrivers, 6 inches	1	1	2
Screwdrivers, 8 inches	1	1	1
Shears, 8 inches, "Wiss"	1	1	2
Spoke shaves, adjustable, 10 inches	1	2	4
Squares, steel framing, 24 by 16 inches	1	2	2

WOODWORKING AREA (Cont.)

	Small	Medium	Large
Hand Tools (Cont.)			
Squares, try, 8 inches	3	4	6
Squares, universal, 9 inches, Lufkin No. 65	1	1	2
Stops, bench	2	4	6
Trammel points, with pencil clasp	1	1	1
Wrenches, adjustable, open end, 6, 8, 10 inches	1 ea	1 ea	1 ea

METAL WORKING AREA

Sheet, Art and Bench Metals			
Bar folder, 30 inches, adjustable		1	1
Bench brush	2	4	6
Bench, sheet metal	1	1	2
Bench, soldering and furnace	1	1	1
Bending jig, flexo	1	1	2
Buffing head	1	1	1
Counter sink, ¾ inch, for wood or metal	1	1	2
C clamps, 6 inches	2	4	6
Chisel, cold, ⅜, ½, ¾ inch	1 ea	1 ea	2 ea
Dividers, 8 inches, solid nut	1	2	2
Drills, set of high speed, fraction hy 64ths, 1/16 to ½ inch	1 set	1 set	1 set
Drill, hand, ⅜ inch	1	1	2
Folder, hand	1	1	1
File cards	1	2	3
Furnace, bench type, natural gas or gasoline	1	1	2
Gauge, U. S. standard	1	1	1
Goggles, safety	1 pr	2 pr	2 pr
Groover, hand, No. 4	1	1	2
Groover, hand, No. 2	1	1	2
Hacksaw frames, 12 inches, adjustable	2	4	6
Hammer, art metal forming	1	2	3
Hammer, art metal planishing, Dixon No. 27	1	1	2
Hammer, ball pein, 6 ounces	2	3	4
Hammer, ball pein, 10 ounces	2	3	4
Hammer, ball pein, 16 ounces	1	2	2
Hammer, rawhide mallet	1	2	2
Hammer, riveting	1	2	3
Hammer, tinner's setting down	1	2	3
Hammer, tinner's mallet, 3 by 6 inches, hickory	1	2	3
Jeweler's saw frame, 5 inches	1	2	2
Nippers, end cutting, 12 inches	1	1	1
Panel, for metalwork tools	1	1	1
Pliers, combination, 6 inches	2	4	6
Pliers, round nose, 6 inches	1	2	2
Punches, hollow, ¼, 3/9, ½ inch	1 ea	1 ea	1 ea
Punches, solid, 3/32, ⅛, ½ inch	1 ea	1 ea	1 ea
Rivet sets, Nos. 4, 5, 6, 8	1 ea	1 ea	1 ea
Rotary machine, Pexto No. 622 complete	1	1	1

METAL WORKING AREA (Cont.)

	Small	Medium	Large
Sheet, Art and Bench Metals (Cont.)			
Rules, steel, 12 inches	1	2	3
Rule, tinner's circumference			1
Rules, wood, 3 feet	2	3	4
Screwdriver, 4 inches	1	2	2
Screwdriver, 6 inches	1	2	2
Screwdriver, 8 inches	1	2	2
Screwdriver, 12 inches		1	1
Scribe	2	4	6
Shears, bench	1		
Shears, Beverly No. 132		1	1
Shears, squaring, 36 inches			1
Snips, tinner's straight, 12 inches	2	3	4
Snips, aviation—"Wiss"		1	1
Snips, tinner's, circle cutting 12 inches	1	1	2
Soldering coppers, 1 pound pair	1	1	1
Soldering coppers, 1½ pound pair		1	1
Soldering coppers, 2 pound pair	1	1	1
Soldering iron, electric		1	1
Stakeholder plate, 10 inches square	1	1	
Square, combination, 12 inches	1	2	3
Stake, hollow mandrel		1	1
Stake, blowhorn	1	1	1
Stake, beakhorn			1
Stake, hatchet	1	1	1
Tap and die set, S.A.E. and N.C.—3/16, ¼, 5/16, 3/8, 7/16, ½ inch	1	1	1
Tap and die set, pipe—⅛, ¼, ⅜, ½, ¾, 1 inch			1
Torch, Presto-lite or natural gas and air	1	1	1
Trammel points	1	1	1
Vises, machinist, 2½-inch jaws	2	3	4
Vise, pipe		1	1
Wire gauge No. 282	1	1	1
Wire brushes	1	1	2
Wrench, pipe, 18 inches	1	1	1
Wrench, pipe, 14 inches		1	1
Wrench, crescent, 4 inches		1	1
Wrench, crescent, 6 inches	1	1	1
Wrench, crescent, 8 inches		1	1
Wrench, crescent, 10 inches	1	1	1
Wrench, monkey, 12 inches	1	1	1
Hot Metals Area			
Forging			
Anvil, 100 pounds—polished face and horn	1	1	2
Anvil base	1	1	2
Anvil hardy, 1-inch shank	1	1	2

METAL WORKING AREA (Cont.)

	Small	Medium	Large
Hot Metal Area (Cont.)			
Chisel, cold cut, handled, 1½ inches	1	1	1
Chisel, hot cut, handled, 1¾ inches	1	1	1
Fire extinguisher	1	1	2
Flatter, square, 2 by 2 inches			1
Forge, (gas fired, Johnson No. 120) or (open hearth, cast iron heavy duty 18 by 20 inches, hand blower)	1	1	2
Fuller, bottom, ¼ and ½ inch			1 ea
Fuller, top with handle, ¼ and ½ inch			1 ea
Hammer, ball pein, 24 ounces	1	1	2
Hammer, ball pein, 32 ounces	1	1	2
Hammer, blacksmith's hand, 4 pounds	1	2	2
Hammer, blacksmith's sledge, 8 pounds		1	1
Panel for forging tools	1	1	1
Punch, round, with handle		1	1
Swage, top, ¼ and ½ inch			1 ea
Swage, bottom, ¼ and ½ inch			1 ea
Tongs, blacksmith's curved lip	1	2	3
Tongs, blacksmith's pick-up	1	2	3
Vise, Columbia, leg, 4 inches		1	1
Foundry			
Bellows, molder's	1	1	2
Bench, molding, metal lined	1	1	2
Boards, molding, to fit flasks	4	6	8
Bulb, sponge, 4 ounces	1	1	2
Crucible tongs	1	1	1
Flasks, molder's, 10 by 12 inches	1	1	2
Flasks, molder's, 12 by 16 inches	1	1	2
Flasks, molder's, 16 by 20 inches		1	1
Founder's trowel	1	1	2
Founder's slick and spoon	1 ea	1 ea	2 ea
Goggles, safety	1	2	2
Ladle, 6-inch bowl, 35-inch handle	1	1	1
Melting furnace, blower type, Johnson No. 550, complete with graphic crucible and steel pot	1	1	1
Pyrometer			1
Panel, for foundry tools	1	1	1
Rammer, hardwood, 3½ by 14 inches	2	2	4
Riddle, foundry, ¼ inch mesh	1	1	2
Sand, foundry, 125-pound bag	2	2	4
Shovel, square point, short handle	1	1	2
Sprue cutter	1	1	2

METAL WORKING AREA (Cont.)	Small	Medium	Large
Hot Metal Area (Cont.)			
Welding			
Arc welder, A.C. or D.C.—200 amperes complete with cables, electrode holder, ground clamp, and helmet	1	1	2
Arc welding accessories			
Welding helmet with No. 10 filter and cover lenses	1	1	2
Hand type helmet with No. 10 filter and cover lenses	1	1	1
Chipping hammer and brush	1	1	2
Welders' gloves, gauntlet type	2	2	4
Arc welding booth with table	1	1	2
Gas welding outfit, complete with cutting attachment, gauges, hose, goggles, wrenches, lighter	1	1	2
Gas welding accessories			
Welders' gloves, gauntlet type	1	1	2
Welding tips—set of 6	1	1	2
Welders' goggles—spectacle type	1	1	2
Gas welding table—fire brick top	1	1	2
Panel for welding accessories	1	1	1
Machine Tool Area			
Arbor press	1	1	1
Calipers, inside, 8 inches	1	1	2
Calipers, outside, 8 inches	1	1	2
Center gauge No. 391	1	1	2
Clipper belt lacer		1	1
Combination counter sink and drill	1	1	2
Drill, electric		1	1
Drill press, 15-inch floor model complete with motor key and chuck	1	1	1
Drill press accessories			
Drill press vise	1	1	1
V-blocks and clamps	1	1	1
Engine lathe—10 inches quick change complete with motor and standard attachments as follows:	1	1	2
Face plate 6 inches			
Face plate 8 inches			
Thread cutting stop			
Tool post assembly			
Centers			
Reducing sleeve for headstock center			

METAL WORKING AREA (Cont.)

	Small	Medium	Large
Machine Tool Area (Cont.)			
Engine lathe accessories			
Boring bar	1	1	1
Center, crotch		1	1
Chuck, Jacobs drill, No. 2 Morse taper shank	1	1	1
Chuck, universal, with 2 sets of jaws		1	1
Collets and draw in attachments			1
Dog, lathe, ¾ inch		1	2
Dog, lathe, 1 inch	1	1	2
Dog, lathe, 1¼ inches		1	2
Dog, lathe, 1½ inches	1	1	1
Dog, lathe, 1¾ inches		1	1
Dog, lathe, 2 inches		1	1
Follow rest		1	1
Independent chuck with reversible jaws	1	1	1
Indicator, dial (set)	1	1	1
Mandrel, ½ inch	1	1	1
Mandrel, ⅝ inch	1	1	1
Mandrel, ¾ inch	1	1	1
Mandrel, 1 inch		1	1
Milling and keyway cutting attachments	1	1	
Steady rest	1	1	2
Tool holder, cut off	1	1	2
Tool holder, knurling	1	1	2
Tool holder, left hand	1	1	2
Tool holder, straight	1	1	2
Tool post grinder			1
Gauge, screw pitch	1	1	1
Grinder, ½ H.P. pedestal	1	1	1
Hacksaw, power, 5 by 5 inches, complete with motor and vise			1
Metal shaper, 7 to 10 inch bench model and stand complete with motor, belt guards, crank handle, and wrench		1	1
Metal shaper accessories			
Rotary index table			1
Swivel vise and wrench		1	1
Tool holder		1	1
Tool holder, extension		1	1
Micrometer, 0-1 inch	1	1	2
Micrometer, 1-2 inches	1	1	1
Micrometer, 2-3 inches		1	1
Milling machine complete with motor, safety belt guards, and arbor			1
Milling machine accessories			
Index centers			1

METAL WORKING AREA (Cont.)

	Small	Medium	Large
Machine Tool Area (Cont.)			
Metal slitting saw, 2½ inches diameter by ⅛ inch			1
Shank, cutter adapter			1
Slat milling cutter, 2½ inches diameter by 1 inch face			1
Spiral end mills, ¼, 5/16, ⅜, ½ inch			1
Vise, swivel			1
Woodruff key cutters, ⅛, 3/16 inch			1
Oil cans, ½ pint	1	2	4
Punch, center	1	2	3
Reamers, ½, ⅝, ¾, 1 inch	1 set	1 set	1 set
Rules, steel, 6 inches	2	3	4
Surface gauge, universal			1
Surface plate			1
Screw extractor, 1 set	1	1	1
Square, combination with centering head	1	2	2
Taper shank drill bit, 39/64 inch	1	1	1
Taper shank drill bit, ⅝ inch	1	1	1
Taper shank drill bit, 47/64 inch	1	1	1
Taper shank drill bit, ¾ inch	1	1	1
Taper shank drill bit, 63/64 inch		1	1
Taper shank drill bit, 1 inch		1	1
Vise, machinist, 3½ inches, swivel base	1	2	3
Wheel dresser, grinding, Carborundum No. 55	1	1	1

ELECTRICITY AREA

Equipment			
Ammeter, A.C. 0-10 amps	1	1	2
Ammeter, D.C. 0-10 amps	1	1	2
Analyzer, supersensitive, 10 amps		1	2
Battery, 6 volt storage	1	1	1
Bench, electrical, with panel	1	1	2
Box, ceiling, shallow, 3¼ inches	1	2	3
Box, covers, 3¼ inches	1	2	3
Box, octagonal outlet, 3¼ inches	1	2	4
Burglar alarm, open and closed circuit		1 ea	1 ea
Buzzer	1	2	3
Compass, magnetic	1	1	1
Doorbells	1	2	3
Door chimes			1
Drill, hand	1	2	2
Drills, twist			
1/16 inch	1	2	3
3/32 inch	1	2	2
⅛ inch	2	3	4
3/16 inch	1	2	3
¼ inch	2	3	4

ELECTRICITY AREA (Cont.)

	Small	Medium	Large
Equipment (Cont.)			
Duplex receptacle	2	3	4
Duplex receptacle plates	2	3	4
Generator, alternating current		1	1
Generator, direct current	1	1	2
Ground clamp	2	3	4
Ground rod	1	1	1
Knives	2	2	3
Magnets, bar	2	3	4
Magnets, natural (horseshoe)	1	2	2
Milliammeter, A.C. 0-50 milliamperes		1	1
Milliammeter, DC. 0-100 milliamperes		1	1
Motor, direct current	1	1	1
Motor—generator			1
Pliers, diagonal	1	2	3
Pliers, combination, 6 inches	2	2	3
Pliers, slender nosed side cutter	2	2	3
Plug, attachment	2	3	4
Plug, base	2	3	4
Punches, center	2	3	3
Push button, doorbell	2	3	5
Receptacle, porcelain PC, 3¼ inches	1	2	4
Receptacle, porcelain keyless, 3¼ inches	1	2	4
Relays		1	1
Rules, steel, 1 foot	1	2	2
Saw, hack	1	2	2
Scriber	1	1	2
Screwdriver set, Phillips	1 set	1 set	2 sets
Screwdrivers, shock proof, thin blade			
2½ inches	2	3	3
4 inches	1	2	3
6 inches	1	1	2
Sockets, pull chain switch	2	3	4
Sockets, push through switch	2	3	4
Sockets, twist switch	2	3	4
Sockets, 2 way Y	2	2	3
Soldering iron, electric, 110-115V	1	2	3
Switch box	2	2	3
Switch, circuit breaker	1	1	1
Switch, double pole, 1 fuse box type	1	1	1
Switch, double pole, 2 fuse box type	1	1	1
Switch, flush toggle	2	4	6
Switch, jackknife, double	1	2	4
Switch plate	2	4	6
Switch, service snap	1	2	4
Switch, SP snap	2	4	6
Switch, SP toggle	**2**	**4**	**6**

ELECTRICITY AREA (Cont.)

	Small	Medium	Large
Equipment (Cont.)			
Switch, 3 day flush	1	1	2
Switch, 3 way snap	1	1	2
Template fly cutter		1	1
Telegraph key	1	2	2
Telegraph sounder	1	2	2
Telephone (complete set)	1	2	2
Tester, electric circuit (handy test light)	1	1	2
Tester, tube, dynamic mutual conductance		1	1
Transformer, door bell, 110-120V primary, 10 V secondary	1	2	3
Vise, 2½ inch jaw	1	2	2
Voltmeter, A.C. 0-250 Volts	1	1	2
Voltmeter, D.C. 0-100 Volts	1	1	2
Wire gauge		1	1
Wire holder, porcelain	2	4	6
Wrench set, electrical "Spintite"		1	1

CRAFT AREA

General			
Carving tools, set	1	1	1
Coping saws	1	2	2
Hammer	1	1	1
Knives	1	1	2
Loom, small		1	1
Paper punch	1	1	1
Pliers	1	2	2
Screwdrivers, small	1	2	2
Stools or chairs	3	4	6
Scissors	1 pr	1 pr	2 pr
Tool cabinet	1	1	1
Vises, bench, 2½ inches	2	3	4
Work table	1	1	1
Leather			
Awl	1	2	2
Bone folder	1	2	2
Cutting board, maple	1	1	2
Draw gauge			1
Drive punch, Nos. 2, 3, 4, 6, 9	1 ea	1 ea	1 ea
Edge creaser	1	1	1
Embossing wheels and carriage			1
Fid	1	2	2
Knife, incising			1
Knife, round		1	1
Knife, skiving, beveled point	1	2	3
Mallet, hard wood	1	1	2
Modeling tool, ball			1

CRAFT AREA (Cont.)

	Small	Medium	Large
Leather (Cont.)			
Modeling tool, deerfoot		1	1
Modeling tools, standard pattern	2	3	3
Needles, assorted sizes, package	1	1	2
Plate glass	1	1	2
Revolving punch	1	1	1
Slitter punch, with gauge	1	2	2
Snap attachment set	1	1	1
Spacer		1	1
Steel square, 7 by 12 inches	1	1	1
Thonging chisel, 3/32 and 1/8 inch	1 ea	1 ea	1 ea
Tracer	1	1	2
Plastics			
(No hand tools are listed for work in plastics as most of the operations can be performed with those tools already listed in the wood and metal areas.)			
Electric oven or hot plate (for heating plastics)	1	1	1
Bending jigs and fixtures (built in the laboratory)			
Polishing head (with motor)	1	1	1
Ceramics			
Clay bin, metal lined	1	1	1
Damp cabinet	1	1	1
Glass jars	6	8	12
Hand tools, potter's	1 set	1 set	2 sets
Kiln, electric, complete	1	1	1
Plaster bats	2	3	4
Potter's wheel			1
Spray gun, hand	1	1	1
Stone jars	2	3	4
Wedging table and wire	1	1	1
Whirlers, table type	1	2	3
Work table, metal top	1	1	1

HOME AND FARM MECHANICS

Axe	1	1	1
Belt lacer			1
Bolt clippers		1	1
Bucket	1	1	2
Edger, for concrete work		1	1
Electric fan	1	1	1
Electric iron	1	1	2
Electric toaster	1	1	1
Faucets, fuller and compression	2	4	6
Flushing tank			1

HOME AND FARM MECHANICS (Cont.)

	Small	Medium	Large
Gas meter		1	1
Grinder, sickle and tool			1
Harness stitching clamp		1	1
Hatchet	1	1	1
Hoe	1	1	1
Lamp fixtures	2	3	4
Light meter	1	1	1
Mixing box (concrete and plaster)		1	1
Mortise lock	1	1	2
Needles (assorted package)	1	1	1
Sand screen	1	1	1
Shears, pruning			1
Shovel	1	1	2
Shut off valve	1	1	1
Sink trap	1	1	1
Scythe whetstone	1	1	1
Trowel, cement and plaster	1	1	2
Trowel, brick	1	2	2
Water meter	1	1	1
Wrecking bar	1	1	1

AUTO MECHANICS AREA

Battery service kit, including pliers, voltmeter, hydrometer, water bulb	1	1	1
Battery water container	1	1	1
Battery carrier (hand)	1	1	1
Battery pliers			1
Body tool set, Fairmont, No. 815	1	1	2
Brush, spoke, washing	1	1	1
Calipers, 8 inches	1	1	1
Calipers, inside spring, 6 inches	1	1	1
Carbon cleaning brushes, rotary, ¼ inch			1 set
Carbon scraper		1	2
Chamois	1	1	2
Chassis, automobile		1	1
Chisels, cold, ⅜-½ inch	1 ea	1 ea	2 ea
Compression tester			1
Connecting rod and piston jig			1
Cylinder gauge			1
Differential hoist (1 ton cap.)		1	1
Dividers, spring	1	1	1
Drill, breast	1	1	1
Drill, electric portable, ¼ inch	1	1	1
Drill, electric portable, ½ inch			1
Drill, hand, ⅜ inch chuck	1	1	1
Drill press, floor model	1	1	2

AUTO MECHANICS (Cont.)

	Small	Medium	Large
Clamps, "C", 2½, 4, 5 inches	3	3	6
Extension cord and light	1	1	2
Flaring tool, tubing		1	1
Gasket punches	1 set	1 set	1 set
Gauges, thickness	2	3	4
Gear puller		1	1
Grease gun, Zerke	1	1	1
Grease gun, alemite	1	1	1
Grinder, bench, heavy duty, ½ H.P.			1
Hack saw frames	1	2	3
Hammers, ball pein, 16, 12 ounces	2	2	4
Jack, hydraulic, small	1	1	1
Jack, hydraulic, caster mount			1
Motor analyzer and tune-up unit			1
Motor blocks for exhibit and disassembly	1	2	2
Oil cans, ⅓ pint, 9-inch spout	1	1	2
Oil cans, waste, 6 gallons	2	3	4
Pliers, combination, 6 inches	2	3	4
Pliers, vise grip	1	1	1
Punches, center	1	2	2
Ring compressor	1	1	1
Rules, hook, 6 inches	1	1	2
Screwdrivers, 2, 3, 4, 6, 8 inches	1 set	1 set	1 set
Screwdrivers, Phillips, sizes 1, 2, 3, 4		1 set	1 set
Screw extractors (easy-out)	1 set	1 set	1 set
Screw pitch gauges, 30 leaves	1	1	1
Scribers	1	1	1
Slide calipers and rule combination			1
Spark plug wrenches	1 set	1 set	1 set
Spark plug cleaner and tester		1	1
Sponges, ½ pound	1	1	2
Square, combination	1	1	2
Tire irons, 1 curved, 2 straight	3	3	3
Tire pressure gauges	1	1	1
Tubing cutter		1	1
Twist drill sets			1
Universal motor stands		1	1
Vise and work bench	1	1	2
Vises, machinist, 3½ inches	1	1	2
Water pump pliers	1	1	1
Wheel pullers	1 set	1 set	1 set
Wrenches, adjustable, open end, 4, 6, 8, 10 inches	4	4	8
Wrenches, 12 pt. box end, 6 wrenches	1 set	1 set	1 set
Wrenches, open end, 6 wrenches	1 set	1 set	2 sets
Wrench, pipe, 12 inches		1	2
Wrench, pipe, 18 inches	1	1	2

AUTO MECHANICS AREA (Cont.)

	Small	Medium	Large
Wrench set, midget electrical	1	1	1
Wrench, rim, 4 way	1	1	2
Wrench socket set, ⅜ inch drive	1	1	2
Wrench, sets, tappet	1	1	1
Pliers, 6 inches, thin nose	1	1	1
Pliers, 6 inches, diagonal cutting	1	1	2
Valve spring lifter	1	1	1
Washing mitt	1	1	1
Wrench, torque	1	1	2
Wrenches, tappet	1	1	2
Wrenches, Allen	1 set	1 set	1 set
Wrench, starter		1	1
Wrench, drain plug	1	1	1

APPENDIX

(Book List)

1. ANNOTATED BIBLIOGRAPHY OF INDUSTRIAL ARTS BOOKS

Listed below are a number of selected books for the various areas of industrial arts. This is not a comprehensive listing and it must be understood that there are other good books available.

Publishers are more than willing to send their books for inspection and study. Their catalogues should be secured for further reference.

PLANNING AND DRAWING BOOKS

Bradley, Charles B., *Design in the Industrial Arts*, The Manual Arts Press, Peoria, Illinois, 1946, 250 pages, cloth cover, $3.00.

Problems of art and design as applied to handicrafts and the selection of manufactured articles. The principles of design are applied to many of the materials common to the industrial arts laboratory. Planned mainly for the instructor, but has value as a student reference.

Baysinger, G. B., and Silvius, G. H., *The Student's Planning Book*, The International Textbook Company, 1943, 64 pages, paper cover, 40 cents.

Suggested procedures for planning projects are listed and described. Planning forms are included and a pupil personnel organization is proposed.

Fryklund, V. C., and Kepler, F. R., *General Drafting*, McKnight and McKnight, Bloomington, Illinois, 1938, 160 pages, paper cover—$1.00, cloth cover—$1.32.

Covers the basic principles of mechanical drawing as they apply to sketching, working drawings, electrical drawings, sheet-metal developments, graphs, charts, and building plans. Provides informational material that shows the relation of drawing and industry. Organized on a unit basis. Well illustrated. A good book for the beginner in this area.

Mattingly, E. H., and Scrogin, Everett, *Applied Drawing and Design*, The McCormick-Mathers Publishing Company, Wichita, Kansas, 1941, 232 pages, paper cover, $1.28.

A clear and well-illustrated treatment of basic operations, and information involved in general drawing and design. Sections devoted to sketching, instrument drawing, machine drawing, woodworking drawing, sheet-metal drawing, aircraft drawing, architectural draw-

PLANNING AND DRAWING BOOKS (Cont.)

ing, graphs and charts, reproduction of drawings and essentials of design. An excellent book, bringing together general material in drawing and design for the beginning student. Includes practical problems.

Bartholemew, R. A., and Orr, F. S., *Learning to Read Mechanical Drawings*, The Manual Arts Press, Peoria, Illinois, 1937, paper cover, 56 cents.

A workbook for beginners. Free hand sketching is used to solve problems in orthographic projection and simple pictorial views. Includes lettering and dimensioning practice.

Bailey, Charles H., *Mechanical Drawing for Beginners*, The Manual Arts Press, Peoria, Illinois, 1940, 96 pages, paper cover, 68 cents.

A brief course in the fundamental principles involved in the making of working drawings. Presents the fundamentals of procedure and practice through concise explanations and illustrative problems. Includes a series of progressive problems for the beginning student.

Green, Daniel, *Drawing for Life and Industry*, The Bruce Publishing Company, Milwaukee, Wisconsin, 1945, 188 pages, paper cover, $1.56.

In this book the author attempts to break away from the traditional pattern of presentation. He illustrates mechanical drawing as applied to a variety of life situations. Attention is given to designing and planning.

French, T. E., and Svensen, C. L., *Mechanical Drawing*, The McGraw-Hill Book Company, New York, 1940, 300 pages, cloth cover, $1.76.

This book is written by two popular authors in the field of drawing. It offers well organized instruction and a large number of problems. Includes sections devoted to instruments, lettering, sketching, working drawings, tracing and reproduction, machine drawing, sheet-metal drawing, architectural and structural drafting, and map drawing. A good book for beginning as well as advanced students.

Berg, Edward, *Mechanicad Drawing*, The Bruce Publishing Company, Milwaukee, Wisconsin, 1942, 180 pages, cloth cover, $2.25.

This book deals with the principles fundamental to the making and reading of mechanical drawings. Divided into units of instruction with some problems to solve. Much use is made of example problems. Deals with working drawings in general, machine drawing, pattern development, pictorial drawing, and architectural drawing. May be used for either beginning or advanced students.

Zipprich, Anthony E., *Freehand Drafting*, D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, 1943, 150 pages, cloth cover, $1.80.

Covers very adequately the use of freehand sketching, which is important to industrial arts planning and drawing. Includes many illustrations and is well organized. Exercises and problems give practice in the material presented. Valuable for the teacher and student.

PLANNING AND DRAWING BOOKS (Cont.)

Klenke, W. W., and Hayes, C. J., *Elementary Mechanical Drawing*, International Textbook Company, Scranton, Pennsylvania, 1940, 250 pages, cloth cover, $1.60.

Designed to develop an understanding of the fundamental principles of mechanical drawing and to develop skill in producing drawings in accordance with drafting-room practice. Includes a good section on freehand sketching. Good for the student who plans to specialize in drawing.

Klenke, W. W., and Hayes, C. J., *Advanced Mechanical Drawing for High Schools*, International Textbook Company, Scranton, Pennsylvania, 1941, 316 pages, cloth cover, $1.75.

The authors have designed this book to give an advanced understanding of the fundamental principles of mechanical drawing, and continue the aims of their previous book. Includes developments and intersections, machine drawing, architectural drawing, perspective, and reproduction. For the advanced student and the industrial arts teacher.

Hoelscher, R. P., and Mays, A. B., *Mechanical Drawing*, John Wiley & Sons, Inc., New York, 1941, 305 pages, cloth cover, $1.60. (Book One.)

Covers care and use of drawing instruments, orthographic projection, working drawings, geometric constructions, machine drawings, and building plans. Includes many drawing problems. Well organized. For beginning and advanced students.

French, Thomas E., *Engineering Drawing*, The McGraw-Hill Book Company, Inc., New York, 1941, 622 pages, cloth cover, $3.50.

A comprehensive book covering engineering drawing. The instruction material is very well organized and illustrated. A great variety of problems are included. Designed as a college textbook but a very valuable reference for the teacher and advanced student in industrial arts.

Buss, T. C., *Simplified Architectural Drawing*, American Technical Society, Chicago, 1946, 258 pages, cloth cover, $4.75.

This book provides a comprehensive general knowledge of the principles, methods, and techniques involved in architectural drawing. Very well organized and illustrated with photographs and line drawings. A good book for the student interested in architecture.

Ericson, E. E., and Soules, R. L., *Planning Your Home*, The Manual Arts Press, Peoria, Illinois, 1938, 131 pages, cloth cover, $2.60.

Fundamental considerations in home planning with suggested working units. Covers materials, styles of architecture, and details of planning. A good text for courses in house planning and valuable as a reference book for advanced students in drawing.

Dalzell, J. R., and McKinney, James, *Architectural Drawing and Detailing*, American Technical Society, Chicago, 1946, 212 pages, cloth cover, $2.50.

This book presents the general principles, practices, and techniques of architectural drawing and detailing. A good reference book.

PLANNING AND DRAWING BOOKS (Cont.)

Waffle, Harvey W., *Architectural Drawing for High Schools*, The Bruce Publishing Company, Milwaukee, Wisconsin, 1939, 320 pages, cloth cover, $2.75.

A basic text for beginning classes in architectural drawing. Written for the high school student. Presents a general knowledge and training in the building trades as applied specifically to houses.

Williams, Paul R., *The Small Home of Tomorrow*, Murray and Gee, Inc., Hollywood, California, 1945, 95 pages, cloth, $3.00; paper cover, $2.00.

Presents sketches of floor plans and elevations for forty modern homes designed by a well known architect. Suggestions are given for planning bathrooms, kitchens, selecting the site, etc.

Wills, R. Berry, *Homes for Homemakers*, Franklin Watts, Inc., 285 Madison Avenue, New York, 17, New York, 1945, 94 pages, paper cover, $1.00.

Includes fifty sketches and plans, ten pages of details and things to look for when building a house.

WOODWORKING BOOKS

Douglass, J. H., and Roberts, R. H., *Units in Hand Woodworking*, The McCormick-Mathers Publishing Company, Wichita, Kansas, 1946, 160 pages, paper cover, $1.00.

Covers informational and operational units in hand woodworking in an effective manner. Includes some related information and short units on elementary wood finishing. Many drawings and pictures illustrate each unit. Well designed for beginning students in woodwork. Includes a number of representative projects.

Fryklund, Verne C., and LaBerge, A. J., *General Shop Woodworking* (Third Edition), McKnight and McKnight Publishers, Bloomington, Illinois, 1946, 160 pages, paper cover, $1.00.

Covers basic hand woodworking, tools, and operations in an effective manner. Includes some related information of a general nature. Organized on an operational and informational unit basis. Questions are included at the end of each unit. Many line drawings are used to illustrate procedures and explanations. Well adapted to the needs of junior high school students. Includes 25 projects in woodwork.

Hjorth, Herman, *Basic Woodworking Processes*, The Bruce Publishing Company, Milwaukee, Wisconsin, 1935, 250 pages, cloth cover, $2.00.

A very comprehensive treatment of hand woodworking processes and operations. Includes related information about hand tools and materials. One chapter is devoted to wood finishing. Material is well organized, illustrated, and presented. Valuable for either junior or senior high school students.

Shea, John G., and Wenger, Paul N., *Woodworking for Everybody*, International Textbook Company, Scranton, Pennsylvania, 1944, 187 pages, cloth cover, $2.40.

WOODWORKING BOOKS (Cont.)

This book covers basic woodworking processes, techniques and information. There is a well illustrated section devoted to the lumbering industry and wood products. Hand tools are introduced in family groups using animated characters, a method which should have strong appeal to younger students. There are sections dealing with wood finishing and woodworking machinery. Includes 46 carefully selected projects. Well illustrated in half-tone and line drawings. Good binding.

Johnson, W. H., and Newkirk, L. V., *General Woodworking*, The MacMillan Co., New York, 1946, 283 pages, cloth cover, $2.00

A general treatment of all the common areas of woodworking. Presents the basic information and principles involved in the following skills: hand and machine woodworking, wood finishing, cabinet making, carpentry, pattern making, and wood carving. Includes a short unit on the home workship. Questions, topics for discussion, and bibliographies are included. Very well illustrated with photographs and line drawings.

Sowers, J. I., *Visualized Projects in Woodworking*, The McGraw-Hill Book Company, Inc., New York, 1945, 89 pages, cloth cover, $1.60.

A book of plans, projects, processes, and procedures for the seventh, eighth, and ninth grades. Well illustrated.

Hjorth, Herman, *Principles of Woodworking*, The Bruce Publishing Company, Milwaukee, Wisconsin, 1946, 446 pages, cloth cover, $2.88.

A book covering hand and machine woodworking for the advanced student. Tool operations are described and written in instruction-sheet form. Cabinet making and joinery are emphasized. Information about tools, machines, and materials is presented. Review questions are given at the end of each section. Well illustrated.

Hjorth, Herman, *Operations of Common Woodworking Machines*, The Bruce Publishing Company, Milwaukee, Wisconsin, 1942, 163 pages, cloth cover, $1.75.

This book shows by illustrations and descriptions how to operate the common woodworking machinery. It includes a description of each of the common machines and some jigs and fixtures that may be used. Safety factors are stressed. Illustrated with line drawings. A good book for the beginner in machine woodwork.

Hjorth, Herman, *Machine Woodworking*, The Bruce Publishing Company, Milwaukee, Wisconsin, 1937, 371 pages, cloth cover, $3.25.

A comprehensive and detailed treatment of woodworking machines. Deals with machine operations, jigs, and appliances. Production machines are described and illustrated. Safety rules are given for each type of machine. Questions and references accompany each chapter. Material is well organized and illustrated with photographs and drawings. For the advanced student.

Delta Manufacturing Company, *Operation Manuals for Woodworking Equipment*, Milwaukee 1, Wisconsin.

WOODWORKING BOOKS (Cont.)

Getting the Most Out of Your Drill Press..No. 4530, Price 25 cents
Getting the Most Out of Your Abrasive Tools .....No. 4531, Price 25 cents
Getting the Most Out of Your Band Saw and Scroll Saw .....No. 4532, Price 25 cents
Getting the Most Out of Your Circular Saw and Jointer .....No. 4533, Price 25 cents
Getting the Most Out of Your Lathe.....No. 4534, Price 25 cents
Getting the Most Out of Your Shaper.....No. 4535, Price 25 cents

These handbooks describe the operation of small power tools. For both the beginning and advanced student. Well illustrated with photogràphs and line drawings.

Klenke, William W., *The Art of Wood Turning*, The Manual Arts Press, Peoria, Illinois, 1937, 122 pages, cloth cover, $2.25.

Instruction in the art of wood turning. Progresses from simple to advanced work. Includes rechucking, built-up and segment work.

Waring, Ralph G., *Wood Finishing and Painting Made Easy*, The Bruce Publishing Company, Milwaukee, Wisconsin, 1940, 220 pages, cloth cover, $2.75.

Covers cabinet woods and their finishes. Includes information about materials and treats carefully the processes involved. Introduces recent techniques and the use of modern equipment. A comprehensive but clearly written and well illustrated publication. Valuable to the home craftsman, finisher, or instructor of industrial arts.

Townsend, Gilbert, *Carpentry*, American Technical Society, Publishers, Chicago, Illinois, 1935, 436 pages, cloth cover, $2.50.

A practical treatise on simple building construction, general carpentry work, exterior and interior finish, building forms and working drawings.

Ritchey, Monroe, Beese, Hall, *Pattern Making*, American Technical Society, Publishers, Chicago, Illinois, 1938, 233 pages, cloth cover, $2.25.

Covers fully the subject of pattern making, describing the tools and equipment, design of simple and complicated patterns and the construction and design of typical molding machinery. Of value to the advanced student interested in pattern making and founding.

Baxter, William T., and Lackey, Paul Gordon, *Woodworking Projects and Upholstery*, D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, 1942, 251 pages, cloth cover, $2.80.

Written for the home craftsman and advanced student in woodworking. Covers most of the hand tools and small woodworking machines. Pictures and working drawings of small pieces of furniture. Includes a section on upholstery.

Mankin, Victor J., *Modernistic Chip Carving*, The Bruce Publishing Company, Milwaukee, Wisconsin, 1942, 70 pages, paper cover, $1.25.

Covers tools, materials, and processes used in chip carving. Design is discussed. Sample projects are shown. Well illustrated.

WOODWORKING BOOKS (Cont.)

Champion, Paul V., *Birdhouses*, The Bruce Publishing Company, Milwaukee, Wisconsin, 1936, 96 pages, cloth cover, $1.50.

Photographs, drawings, and descriptions of a number of well designed birdhouses. Includes a brief description of the type of home required by each bird.

Kay, J., and White, C. T., *Toys, Their Design and Construction*, The Manual Arts Press, Peoria 3, Illinois, 1944, 125 pages, cloth cover, $3.65.

Photographs, drawings and explanations for making a variety of toys. For both the beginning and advanced student.

Laberge, Armand J., *Boats, Airplanes, and Kites*, The Manual Arts Press, Peoria, Illinois, 1935, 132 pages, cloth cover, $2.50.

Things boys like to build. The construction of these articles will provide desirable activities both in and outside the laboratory.

Hjorth, Herman, *Forty Pieces of Fine Furniture*, The Bruce Publishing Company, Milwaukee, Wisconsin, 1939, 171 pages, cloth cover, $3.00.

Offers photographs and working drawings of furniture which will provide suggestions and ideas for the advanced student. Includes a section on veneering and inlaying, simple carving and wood finishing.

Hooper, Rodney, *Modern Furniture Making and Design*, The Manual Arts Press, Peoria, Illinois, 1939, 160 pages, cloth cover, $5.00.

This book shows a variety of treatments for the design and construction of furniture and woodwork. A reference book for the instructor and advanced student.

Varnum, William H., *Creative Design in Furniture*, The Manual Arts Press, 237 North Monroe Street, Peoria 3, Illinois, 1937, 153 pages, cloth cover, $3.00.

Presents the principles and the creative approach to modern design in furniture. Deals with wood, metal, glass, and plastics. Line drawings are used to illustrate the principles.

Stanley Safety Charts, Stanley Tools, Educational Department, New Britain, Connecticut, set, $2.50.

A set of 18 cards, printed on both sides in color; cards are 12 by 18 inches.

Silvius, G. H., and Baysinger, G. B., *Safe Work Practice in Woodworking*, American Technical Society, Chicago, Illinois, 1946, 82 pages, paper cover, 60 cents.

Safety instructions for hand and machine woodworking. Well illustrated.

METAL WORKING BOOKS

(General)

Johnson and Newkirk, *The Metal Crafts*, The MacMillan Company, Chicago, Illinois, 130 pages, cloth cover, $1.50.

A well illustrated book, designed as a pupil's text in either junior high school or senior high school classes. It may be used for one of the instructional areas in an industrial arts laboratory or in a course devoted exclusively to general metal work. Covers metals industries, art metal, metal spinning, sheet metal, molding, and tools.

Ludwig, O. A., *Metal Work Technology and Practice*, McKnight and McKnight, Bloomington, Illinois, 1943, 400 pages, 662 illustrations, cloth cover, $4.00.

An introductory course in the metal crafts. Well adapted as a text or reference book. Simply written and profusely illustrated, covering 12 different phases of metal work with 57 units of instruction. Especially adapted to beginners in junior and senior high school.

Tolliver, R. R., and Lewis, W. C., *Care and Use of Hand Tools*, John Wiley and Sons, New York, 1944, 95 pages, cloth cover, $1.50.

An elementary manual on hand tools used in machine shops with demonstration and discussion guide. A good reference book.

(Bench, Sheet, and Art Metal)

Beck, W., Jr., *Metal Working Made Easy*, Bruce Publishing Company, Milwaukee, Wisconsin, 1942, 112 pages, cloth cover, $1.60.

Designed for beginning general courses in metal work. Divided into three divisions—art metal, sheet metal, and ornamental iron. Well illustrated, and procedures outlined.

Bick, A. F., *Artistic Metal Work*, Bruce Publishing Company, Milwaukee, Wisconsin, 1940, 244 pages, cloth cover, $3.25.

Planned for those who are seeking good design in metal projects. Covers thin metals, wrought iron, cast metals, and one tool steel project. A good reference book. Primarily for senior high schools.

Dragoo, A. W., and Reed, H. O., *General Shop Metal Work*, McKnight & McKnight, Bloomington, Illinois, 1947, 104 pages, paper cover, $1.00.

An introduction to bench metal work, using very limited equipment and materials, as might be found in a diversified industrial arts program.

Feirer, John L., *Modern Metal Craft*, Manual Arts Press, Peoria, Illinois, 1947, cloth cover, $3.50.

An interesting variety of art metal projects with complete directions for producing each, plus essential technical information. Well adapted for senior high schools.

METAL WORKING BOOKS (Cont.)

Bench, Sheet and Art Metal (Cont.)

Groneman, D. H., *Bent Tubular Furniture*, The Bruce Publishing Company, 1941, 120 pages, cloth cover, $2.00.

How to make light tubular furniture. For senior high school classes of advanced students.

Krom, Paige, *Hand Wrought Iron Work*, Bruce Publishing Company, Milwaukee, Wisconsin, 1946, 195 pages, $1.25.

A group of 47 well designed ornamental iron projects with operations listed in sequence.

Lukowitz, J. J., *Interesting Art Metal Work*, Bruce Publishing Company, Milwaukee, Wisconsin, 1938, 64 pages, paper cover, 50 cents; cloth cover, $1.00.

This beginner's manual presents 20 simple projects. Lists materials required and procedures to follow. Includes suggestions for decoration of metal projects.

Payne, Arthur F., *Art Metal Work With Inexpensive Equipment*, Manual Arts Press, Peoria, Illinois, 1929, 176 pages, cloth cover, $3.50.

An older book with good balance of techniques, procedures, design, and suggested projects.

Reagan, J. E., and Smith, E. E., *Metal Spinning*, Bruce Publishing Company, Milwaukee, Wisconsin, 1936, 80 pages, cloth cover, $1.25.

Especially developed for those with no previous experience in metal spinning. A beginner's guide.

Tustison, F. E., and Kranzusch, R. F., *Metal Work Essentials*, The Bruce Publishing Company, 1936, 176 pages, cloth cover, $1.75.

For beginning general metal work with a minimum of equipment.

(Hot Metals)

Jennings, R. F., *General Shop, Gas and Arc Welding and Cutting*, McKnight and McKnight, Bloomington, Illinois, 1937, 89 pages, paper cover, $1.00.

This book presents elementary fundamentals of both acetylene and A.C. arc welding. Illustrations help show method of performance for basic operations and some industrial applications.

Johnson, C. G., *Forging Practice*, American Technical Society, Chicago, Illinois, 1946, 130 pages, cloth cover, $1.50.

A technical presentation of hand forging, production forging, and heat treatment of steel. A good reference book for advanced classes.

Lincoln Electric Company, *Lessons in Arc Welding*, Lincoln Electric Company, Cleveland, Ohio, 1945, 195 pages, $1.25.

A simplified arc welding instruction guide, well illustrated and easily understood. There is a section of questions and answers for each of the 61 lessons. Usable in both junior and senior high school.

METAL WORKING BOOKS (Cont.)

Hot Metals (Cont.)

Potter, Morgan H., *Oxyacetylene Welding*, American Technical Society, Chicago, Illinois, 1940, 130 pages, cloth cover, $1.50.

An elementary guide on acetylene welding for beginners, on the eighth or ninth grade level.

Stimpson, Gray, Grenman, *Foundry Work*, American Technical Society, Chicago, Illinois, 1947, 216 pages, cloth cover, $2.25.

This book presents a series of molding problems and the use of production molding machines and devices. Casting operations include materials, melting and pouring methods, metallurgy of cast metals, and non-ferrous castings. Primarily for senior high schools and advanced courses.

(Machine Tools)

King, Lewis E., *Milling Machine Operations*, The MacMillan Company, New York, 1944, 123 pages, $1.60.

Designed to help students learn to perform the various milling machine operations. Can be used as a shop theory text or procedure guide in selection of tools and attachments needed in performing a given assignment. Well adapted for students in machine shop.

Knight, Roy E., *Machine Shop Projects*, McKnight and McKnight, Bloomington, Illinois, 1943, 112 pages, paper cover, $1.00.

This book of detailed blueprint projects with associated operation sheets is well suited for students in beginning bench metal and metal turning in either junior high or senior high school.

Shuman, John T., *Machine Shop Work*, American Technical Society, Chicago, Illinois, 1947, 507 pages, $3.50.

The author presents machine shop work from the "how to do it" point of view. Includes the fundamentals behind the tools of industry with special emphasis on the operation of standard machines. A book for senior high schools and advanced classes.

South Bend Lathe Works, *How to Run a Lathe*, South Bend Lathe Works, South Bend, Indiana, 1939, paper cover, 50 cents.

Presents the essential information required to run an engine lathe. Especially designed for beginners.

South Bend Lathe Works, *The South Bend Machine Shop Course*, South Bend Lathe Works, South Bend, Indiana, 1939, 128 pages, paper cover, 50 cents.

A series of 12 lathe projects for beginners in metal lathe work presented with working drawings and operation sheets.

Whipple, G. G., and Baudek, A. C., *Engine Lathe Operations*, McKnight and McKnight, Bloomington, Illinois, 1942, 160 pages, paper cover, $1.60.

Operation units with necessary technical information for selected jobs. All basic lathe operations are presented in logical step by

METAL WORKING BOOKS (Cont.)

Machine Tools (Cont.)

step sequence. An exceptionally well illustrated manual, simple enough for beginners and technical enough for advanced students. Usable as a text or reference book.

Graman, Herman R., *A Good Mechanic Seldom Gets Hurt,* American Technical Society, Chicago, Illinois, 95 pages, paper cover, 75 cents.

Instruction in personal, tool, and machine safety in all the areas of metal working.

ELECTRICITY AND RADIO

Collings, Merel D., *Projects in Electricity,* McKnight and McKnight, Bloomington, Illinois, 1941, 80 pages, paper cover, $1.00.

A book of 21 projects that can be made in the industrial arts laboratory. Contains illustrations and construction hints.

Cook, Sherman R., *Electrical Things Boys Like to Make,* The Bruce Publishing Company, Milwaukee, Wisconsin, 1947, 205 pages, cloth cover, $2.25.

A book of 33 projects which have been tried out for high school use and found to contain excellent teaching materials of interest to boys.

Cornetet, W. H., and Fox, D. W., *Principles of Electricity,* McKnight and McKnight, Bloomington, Illinois, 1946, 255 pages, paper cover, $1.60.

This text has for its purpose the teaching of basic principles of electricity. Designed for day school or evening classes. Has a series of objective tests on various phases of the course as well as assignment units for each job involved.

Dragoo, A. W., and Dragoo, K. L., *General Shop Electricity,* McKnight and McKnight, Bloomington, Illinois, 1946, 132 pages, paper cover, $1.00.

A manual that consists of wiring diagrams, circuit layouts, wiring plans, fundamental electric connections, basic theoretical information and interesting electrical projects for students in junior or senior high school. Well illustrated.

Esty, William, and Millikan, R. A., and McDouglas, W. L., *Elements of Electricity,* American Technical Society, Chicago, Illinois, 1945, 295 pages, cloth cover, $2.00.

This is an excellent book for beginners. The authors of this book have been able to present a comprehensive review of the field of electricity, its fundamental laws, and their practical application in the business and industrial world.

Gorder, L. O., and Hathaway, Kenneth A., *Fundamentals of Radio,* American Technical Society, Chicago, Illinois, 1943, 373 pages, paper cover, $2.00.

This book is designed to provide a background of technical knowledge, together with principles and fundamentals of electricity. It has

ELECTRICITY AND RADIO (Cont.)

many helpful diagrams which are clear and concise. A minimum of mathematics is used. There are many useful tables and an extensive dictionary of technical terms.

Johnson, Wm. H., and Newkirk, Louis V., *The Electrical Crafts*, The MacMillan Company, New York, New York, 1943, 146 pages, paper cover, $1.20; cloth cover, $2.50.

A basal textbook for use in the industrial arts department of junior high schools. Presents a number of electrical projects that boys and girls can build.

Jones, E. W., *Fundamentals of Applied Electricity*, The Bruce Publishing Company, Milwaukee, Wisconsin, 1943, 341 pages, cloth cover, $2.60.

This book is both a classroom text and a shop manual. Part I gives the fundamental working principles of electricity and magnetism, presented through the use of descriptions, pictures, and samples. In Part II directions are given for the construction and use of experimental apparatus, shop equipment, and classroom projects.

Lush, C. K., and Engle, G. E., *Industrial Arts Electricity*, The Manual Arts Press, Peoria, Illinois, 1946, 144 pages, cloth cover, $2.20.

A text recommended for use in a home mechanics course as well as for all who wish to learn about some of the mysteries of electricity. Also includes fundamental requirements for work in the electrical field.

Marcus, Abraham and William, and Horton, Ralph E., *Elements of Radio*, Prentice-Hall, Inc., New York, 1943, 699 pages, cloth cover, $4.00.

A textbook for beginners in the field of radio. Designed for a one-year course, containing problems, questions, demonstrations, and drawings, as well as a glossary at the end of each chapter.

McDougal, W. L., Ranson, R. R., and Dunlap, C. H., *Fundamentals of Electricity*, American Technical Society, Chicago, Illinois, 1943, 417 pages, cloth cover, $2.00.

This text illustrates and explains electrical principles by observing and describing objects and occurrences with which the student is familiar. Examples are given of their practical application and every day uses.

Timbie, W. H., *Essentials of Electricity*, John Wiley and Sons, Inc., New York, New York, 1931, 306 pages, cloth cover, $2.00.

This introductory book explains the underlying facts and laws of good electrical practice which the efficient workman must understand.

Wellman, William R., *Elementary Radio Servicing*, D. Van Nostrand Company, Inc., New York, New York, 1947, 260 pages, cloth cover, $3.75.

This book is intended to serve as a medium of instruction for those who have already mastered some principles of radio receiver construction and now wish to apply their knowledge to radio servicing. Material presented very simply, with no mathematics used.

CRAFT BOOKS

Roseman, L. P., *Leatherwork*, The Manual Arts Press, Peoria, Illinois, 1945, 71 pages, cloth cover, $2.25.

Leathers, tools, thonging, sewing, skiving, tooling, staining, pressing, and renovating are clearly described in this text.

Cherry, Raymond, *General Leatherwork*, McKnight and McKnight, Bloomington, Illinois, 1946, 108 pages, paper cover, $1.20.

Organized on the basis of operational and informational units. Many project suggestions. Well illustrated.

Cherry, Raymond, *General Plastics*, McKnight and McKnight, Bloomington, Illinois, 1941, 125 pages, paper cover, $1.20.

Lists and describes the fundamental operations. Includes informational units and project suggestions. Well illustrated.

Newkirk, L. V., Hewitt, C., and Zutter, L., *Adventures in Plastics*, The D. C. Heath and Company, 1947, 270 pages, cloth cover, $3.50.

This book is an introduction to work in plastics. It discusses and describes fundamental hand and machine processes. It includes instructions on how to make one hundred carefully described projects which have been tested for durability and the interest factor. It is well illustrated with photographs and line drawings, and is adaptable to either junior or senior high school classes.

DuBois, B. S., *Plastics*, American Technical Society, Chicago, Illinois, 1945, 447 pages, cloth cover, $4.00.

Discusses manufacturing and use of the more important plastic materials and products. If there is a question on plastics the answer is in this book. There is a fine chapter on design.

Lockery, A. J., *Plastics in the School and Home Work Shop*, D. Van Nostrand Company, Inc., New York, 1946, 239 pages, cloth cover, $2.75.

A very good book. Includes sections devoted to plastic materials, equipment, operations and processes, and commercial processes and products. Presents 40 projects adaptable to the industrial arts laboratory.

Mansperger, M. A., and Pepper, Carson W., *Plastics Problems and Processes*, International Textbook Company, Scranton, Pennsylvania, 1946, 350 pages, cloth cover, $3.00.

Gives an excellent story of plastics. Well illustrated. Includes a good section on machine-work and hand-work problems. Contains 65 projects.

Binns, Charles F., *The Potter's Craft*, D. VanNostrand Company, Inc., New York, New York, 1947, 156 pages, cloth cover, $2.40.

Excellent for anyone wanting a good understanding of the craft. Contains many excellent illustrations. Contains a detailed chemical breakdown of glazes.

CRAFT BOOKS (Cont.)

Divine, J. A. F., and Blanchford, *Pottery Craft,* Frederick Warne and Company, Ltd., London and New York. Available through Manual Arts Press, Peoria, Illinois, 85 pages, cloth cover, $2.75.

A most useful text to any teacher of craft work who contemplates introducing pottery as a school craft. A few of the following chapters that are outstanding: "Coiled and Pressed Pottery," "Care and Preparation of Clay," "Firing," and "Slip Decoration."

Groneman, Chris H., *General Bookbinding,* McKnight and McKnight, Bloomington, Illinois, 1947, 64 pages, paper cover, $1.00.

Elementary instruction in hand bookbinding. Clear directions and selected photographs are used to illustrate the procedures. Includes directions for making most of the necessary equipment.

Perry, Kenneth F., and Baab, Clarence T., *The Binding of Books,* Manual Arts Press, Peoria, Illinois, 1940, 160 pages, cloth cover, $2.50.

This book describes and illustrates the various bookbinding processes. One chapter is given to the repairing and rebinding of books, notebooks, and cloth covered pads. Binding record cards and files are suggested and illustrated. The authors have instructed classes in bookbinding at Colorado State College of Education for many years.

Griswold, Lester, *Handicraft, Simplified Procedure and Projects,* Out West Printing and Stationery Company, Colorado Springs, Colorado, 1945, 512 pages, cloth cover, $3.00.

Written by a master craftsman in the areas of leather, plastics, metals, wood, pottery, weaving, and Indian crafts. Well illustrated with photographs and line drawings. Very comprehensive and thorough in content. Valuable for any level of craft work.

Hunt, W. Ben, *Ben Hunt's Whittling Book,* The Bruce Publishing Company, Milwaukee, Wisconsin, 1945, 127 pages, cloth cover, $2.50.

This is a project book on wood carving. A good craft book for students, boy scouts, and girl scouts, and home craftsmen.

Hunt, Leslie L., *Twenty-five Kites That Fly,* The Bruce Publishing Company, Milwaukee, Wisconsin, 1946, 110 pages, paper cover, 75 cents.

Explains kite-making in general. Tells where to fly, how to make adjustments, proper gluing and construction methods.

Cooke, Viva, and Sampley, Julia, *Palmetto Braiding and Weaving,* The Manual Arts Press, Peoria, Illinois, 1947, 127 pages, cloth cover, $3.00.

Goes into detail on the uses of palm or palmetto fronds. Some excellent projects are shown.

HOME AND FARM MECHANICS BOOKS

Bedell, E. L., and Gardner, E. G., *Household Mechanics,* 2nd edition. International Textbook Co., Scranton, Pennsylvania, 1945, 225 pages, cloth cover, $2.40.

A very good text and reference book for beginning home mechanics courses in junior or senior high schools. Well illustrated and presented in 148 interesting units covering a wide variety of problems.

HOME AND FARM MECHANIC BOOKS (Cont.)

Di Bernardo and seven others, *Home Mechanics Handbook*, Van Nostrand Company, 250 Fourth Avenue, New York, New York, 804 pages, cloth cover, $5.95.

This is really an encyclopedia of tools, materials, methods, and directions of hundreds of jobs related to the home. A very good reference book for students and instructors.

Johnson and Newkirk, *Home Mechanics*, MacMillan Company, New York, New York, 1947, 302 pages, cloth cover, $2.40.

The many well illustrated problems presented in this book were selected because of their frequent occurrence in home living and their common interest appeal. Desirable for either a class text or reference manual.

Roehl, Louis M., *The Farmer's Shop Book*, Bruce Publishing Company, Milwaukee, Wisconsin, 1945, 466 pages, cloth cover, $2.48.

This farm shop book is especially designed as a text or reference book for the student. Many basic problems of repair, construction, and maintenance common to the farm are presented. Well illustrated.

AUTOMOBILE AND AIRCRAFT MECHANICS

Crouse, Wm. H., *Everyday Automobile Repairs*, McGraw-Hill Book Company, Inc., 330 West Forty-second Street, New York 18, New York, 1946, 287 pages, cloth cover, $3.00.

Written in simple, non-technical language. Provides basic information about the operation and repair of the automobile. Satisfactory for beginning students. Illustrated.

Frost, James V., *Automotive Mechanics*, John Wiley and Sons, New York, 1946, 545 pages, cloth cover, $2.00.

The text treats the subject from the theoretical standpoint. Presents the names and location of various parts of the automobile. Outlines the laws of physics and chemistry involved through simple language and appropriate drawings for all grades of high school students.

Hetiner, Joseph, Shidle, Norman G., and Bissel, Thomas A., *Automotive Mechanics*, D. Van Nostrand Company, New York, 1946, 395 pages, cloth covered, $2.80.

This book is designed to help fill the need for better trained personnel for maintaining, repairing, and using modern autmobiles. A great deal of attention is given to design and construction, with a series of questions and suggested projects at the end of each chapter. This book will be very useful at all levels of work.

Kuns, Ray F., *Auto Mechanics*, The Bruce Publishing Company, Milwaukee, Wisconsin, 1943, a series of five books, combination price, $5.00.

Course 1—The Engine .....Paper cover, 272 pages, $1.25
Course 2—Cooling, Lubrication, and
Fuel Systems .....Paper cover, 256 pages, $1.25
Course 3—Automotive Electricity ...Paper cover, 288 pages, $1.25
Course 4—The Power Flow.....Paper cover, 312 pages, $1.25

AUTOMOBILE AND AIRCRAFT MECHANICS (Cont.)

Course 5—Chassis Units .....Paper cover, 320 pages, $1.25
This set of books presents the various units of the car in a simplified manner. Well illustrated with many drawings. A test is found at the end of each chapter. It is intended to be used along with actual work on the various parts of the car.

Kuns-Plumridge, *Automobile Fundamentals*, American Technical Society, Chicago, Illinois, 1946, 788 pages, cloth cover, $4.75.
A clearly written book on the construction, care, and repair of bodies, frames, chassis, clutches, transmissions, front-end suspension, springs, steering gears, and brakes. This book would be very useful in an advanced course.

Kuns-Plumridge, *Automobile Ignition*, American Technical Society, Chicago, Illinois, 1947, 754 pages, cloth cover, $4.25.
This book covers the elementary principles of the construction and repair of the ignition system and related parts. A technical course, very useful to advanced students.

Kuns-Plumridge, *Automotive Engines*, American Technical Society, Chicago, Illinois, 1947, 723 pages, cloth cover, $4.75.
Deals with the construction, care, and repair of engines, carburetors, and cooling systems. A technical description useful as a reference or as a text for an advanced course.

Kuns-Plumridge, *Automobile Maintenance*, American Technical Society, Chicago, Illinois, 1947, 753 pages, cloth cover, $4.75.
Includes motor analysis, wiring diagrams, and data sheets on all popular makes of American cars. Good as a reference.

Norcross, Carl, and Quinn, James D., Jr., *The Aviation Mechanics*, McGraw-Hill Book Company, Inc., New York 18, New York, 1941, 555 pages, cloth cover, $3.20.
A clear, simple, and interesting presentation of modern airplane construction, maintenance, and repair. A great many photographs and drawings are used. This book should help the student of industrial arts to secure a real insight into the aircraft industry.

Lesly, H. G., *Basic Airplane Mechanics*, John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, New York, 1944, 404 pages, cloth cover, $2.75.
This book explains in a simple and fundamental manner the theory of airplane construction and provides directions for repair and maintenance of its various parts. Well illustrated with photographs, drawings, and sectional views.

Ashcroft, C. C., and Easton, J. A. G., *General Shop Work*, The MacMillan Company, 2459 Prairie Avenue, Chicago, Illinois, 1940, 234 pages, cloth cover, $2.40.
Includes in one volume instructional material in the areas of drawing, wood, metal, concrete, leather, auto mechanics, and electricity. Deals with operations, processes, tools, and materials. Well illustrated with many photographs and line drawings.

GENERAL

Williams, Walter Wm., Jr., *Exploring the Arts and Industries*, International Textbook Company, Scranton, Pennsylvania, 1940, 270 pages, cloth cover, $2.00.

Brief and simple discussions and explanations of the various arts and industries listed under such headings as communications, food, shelter, power, and transportation. Well written and illustrated. For the junior high students.

Willoughby, George A., and Chamberlain, D. G., *General Shop Handbook*, The Manual Arts Press, Peoria 3, Illinois, 1943, Second Edition, 96 pages, paper cover, 92 cents. Five or more copies, 62 cents.

Covers briefly the basic units in drawing, wood, metal, plumbing, concrete, and electrical work.

Crispin, Fredric S., *Dictionary of Technical Terms*, The Bruce Publishing Company, Milwaukee 1, Wisconsin, 1936, 284 pages, cloth cover, $2.75.

A valuable reference for the industrial arts student and teacher.

2. MAGAZINES AND PERIODICALS FOR THE INDUSTRIAL ARTS LABORATORY

Deltagram, The, The Delta Manufacturing Company, Milwaukee, Wisconsin, six issues per year, 50 cents per year.

Furniture Manfacturer, Vincent Edwards and Company, Publishers, 342 Madison Avenue, New York, New York, $2.00 per year.

Hobbies, Society of Philatelic Americans, 2810 South Michigan Avenue, Chicago, Illinois, $2.00 per year.

Home Craftsman, Home Craftsman Publishing Corporation, 115 Worth Street, New York, New York, $1.25 per year.

Model Airplane News, Jay Publishing Corporation, 551 Fifth Avenue, New York, New York, $1.25 per year.

Modelmaker, Modelmaker Corporation, 7611 West State Street, Wauwatosa, Wisconsin, $1.50 per year.

Photography, Ziff-Davis Publishing Company, 185 North Wabash Avenue, Chicago 1, Illinois, $3.50 per year.

Popular Homecraft, General Publishing Company, 919 North Michigan Avenue, Chicago, Illinois, $2.00 per year.

Popular Mechanics, Popular Mechanics Company, 200 East Ontario Street, Chicago, Illinois, $2.50 per year.

Popular Science Monthly, Popular Science Publishing Company, 353 Fourth Avenue, New York, New York, $2.50 per year.

Woodworking Digest, Hitchcock Publishing Company, 542 S. Dearborn Street, Chicago 5, Illinois, $2.00 per year.

3. A SELECTED LIST OF PROFESSIONAL BOOKS, MAGAZINES, AND BULLETINS FOR INDUSTRIAL ARTS TEACHERS

BOOKS

Bawden, W. T., and others, *Industrial Arts in Modern Education,* The Manual Arts Press, Peoria, Illinois, 1934, 168 pages, $1.75.

Ericson, E. E., *Teaching the Industrial Arts,* The Manual Arts Press, Peoria, Illinois, 1946, 384 pages, $4.00.

Friese, John F., *Course Making in Industrial Education,* The Manual Arts Press, Peoria 3, Illinois, 1946, 297 pages, $3.00.

May, A. B., and Cassberg, C. H., *School Shop Administration,* Bruce Publishing Company, Milwaukee, Wisconsin, 1943, 228 pages, $2.50.

Newkirk, Louis V., *Organizing and Teaching the General Shop,* The Manual Arts Press, Peoria 3, Illinois, 1947, 195 pages, $4.50.

Struck, F. T., *Creative Teaching: Industrial Arts and Vocational Education,* John Wiley and Sons, Inc., New York, New York, 1938, 623 pages, $3.50.

MAGAZINES

American Builder, The, Simmons Boardman Publishing Company, 105 West Adams Street, Chicago 3, Illlinois, one year, $3.00.

Industrial Arts and Vocational Education, Bruce Publishing Company, 505 West Cherry Street, Milwaukee, Wisconsin, $2.50 per year.

Occupations, The Vocational Guidance Magazine, National Vocational Guidance Association Publishers, 551 Fifth Avenue, New York, New York, $3.50 per year.

School Arts Magazine, Davis Press, Inc., Publishers, 44 Portland Street, Worcester, Massachusetts, $3.00 per year.

School Life, Washington, D. C., U. S. Office of Education, Federal Security Agency, $1.00 per year.

School Shop, Box 100, Ann Arbor, Michigan, $2.00 per year.

BULLETINS

Education and Economic Well-Being in American Democracy, Educational Policies Commission, National Education Association, 1201 Sixteenth Street, N. W., Washington, D. C., 1940, 227 pages, 53 cents.

Improving Instruction in Industrial Arts, Address, Carlton E. Wright, Director, Research Publications, American Vocational Association, 1010 Vermont Avenue, Washington 5, D. C., 25 cents.

Industrial Arts, Its Interpretation in the American Schools, Bulletin, 1937, No. 34. Address, Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., 20 cents.

Industrial Arts Teacher, The, Bulletin of News and Views of the American Industrial Arts Association, Inc., 185 Broadway, Newark 4, New Jersey.

4. SOURCES OF FILMS FOR INDUSTRIAL ARTS

The following industrial and commercial organizations and visual aids bureaus will send upon request their catalogs and listings of moving picture films, film strips, and glass slides. From these the instructor should select and order the films well in advance of the requested date. This is only a partial list and there are other sources of valuable films.

Allis-Chalmers Manufacturing Company
Advertising Department
Tractor Division
Milwaukee 1, Wisconsin

Aluminum Company of America
Motion Picture Department
801 Gulf Building
Pittsburgh 19, Pennsylvania

American Institute of Steel Construction
101 Park Avenue
New York 17, New York

American Rolling Mill Company
Service Staff Department
Middletown, Ohio

Case Company, J. I.
Educational Division
4 W. Eighth Street
Des Moines 9, Iowa

Civil Aeronautics Administration
Audio-Visual Training Aids
City Hall
Kansas City 6, Missouri

Douglas Fir Plywood Association
1707 Daily News Building
Chicago 6, Illinois

Educators Progress Service
Randolph, Wisconsin
(Publish—"Educators Guide to Free Films," price $5.00)

Ford Motor Company
Film Library
Des Moines 9, Iowa

General Electric Company
Visual Education
840 Canal Street
Chicago, Illinois

General Motors Corporation
Department of Public Relations
1775 Broadway
New York City 19, New York

Goodyear Tire and Rubber Company
Motion Picture Department
Akron, Ohio

International Harvester Company
Consumer Relations Department
180 N. Michigan Avenue
Chicago 1, Illinois

Iowa State College
Visual Education Service
Ames, Iowa

Iowa, State University of
Extension Division
Iowa City, Iowa

Jim Handy Organization
230 North Michigan Avenue
Chicago 1, Illinois

Kansas, University of
Bureau of Visual Instruction
Lawrence, Kansas

Missouri, University of
Adult Education and Extension Service
23 Jesse Hall
Columbia, Missouri

Sinclair Refining Company
Merchandising Department
2540 West Cermak Road
Chicago 8, Illinois

South Bend Lathe Works
425 East Madison Street
South Bend 22, Indiana

SOURCES OF FILMS (Cont.)

Standard Oil Company (Indiana)
West Sixth and Locust
Des Moines, Iowa

United Air Lines
School and College Service
Chicago, Illinois

United States Forest Service
Motion Picture Service
U. S. Department of Agriculture
Washington 6, D. C.

United States Steel Corporation
Film Distribution Center
208 South LaSalle Street
Chicago 90, Illinois

Western Electric Company
Motion Picture Bureau
195 Broadway
New York 7, New York

Western Pine Association
Yeon Building
Portland 4, Oregon

Westinghouse Electric Corporation
School Service
306 Fourth Avenue
Pittburgh 30, Pennsylvania

5. FREE OR LOW-COST INSTRUCTIONAL MATERIALS

Much instructional materials of real value can be obtained from manufacturers and distributors of industrial materials and products. Most of this is free to teachers who request it but for some a small charge is made.

The following is a selected list of companies who have printed material or samples available to schools. It is free unless otherwise indicated. Teachers should use school stationery when requesting this material.

ABRASIVES AND GRINDING WHEELS

Behr, Manning Corporation, Troy, New York
Booklets and charts on abrasives and grinding wheels and their uses.

Norton Company, Worcester 6, Massachusetts
Booklets and charts on grinding and abrasive materials and their uses. Charts and samples of abrasives.

The Carborundum Company, Niagara Falls, New York
Booklets and charts on grinding and abrasive materials and their uses.

Minnesota Mining and Manufacturing Company, St. Paul 6, Minnesota
Booklets on abrasives, non-slip floor coverings, masking tape, etc.

AUTO MECHANICS

American Automobile Association, Washington 6, D. C.
Numerous booklets and leaflets on driving and driving training.

K-D Manufacturing Company, Lancaster, Pennsylvania
Booklet showing valve tools and their operation for use of Ford-built motors.

Snap-On Tools Corporation, Kenosha, Wisconsin
Tools for auto mechanics, also educational pamphlets.

FREE MATERIALS (Cont.)

General Motors Corporation, General Motors Building, Detroit, Michigan
Numerous booklets on films, materials, motors, chemistry, physics, etc., pertaining to automobiles. Large wall charts of motors and parts.

Chrysler Corporation, Detroit 31, Michigan
Various booklets and charts on Chrysler-built cars. Write for prices.

AVIATION

Link Aviation, Inc., Binghamton, New York
"Fundamentals of Aviation," 35 cents.
"Aviation Education," 50 cents.

Wright Aeronautical Corporation, Wood-Ridge, New Jersey
Booklets and pictures of airplane engines, etc.

Trans-World Airlines, 110 West Eleventh Street, Kansas City, Missouri
Descriptive and educational booklets on aviation and travel by air.

Pratt and Whitney Aircraft, East Hartford 8, Connecticut
Illustrated booklets and charts on engines, airplanes, etc.

United Air Lines, United Air Lines Building, Chicago 38, Illinois
Booklets and pictures on airplane travel and transportation.

Piper Aircraft Corporation, Lock Haven, Pennsylvania
Various booklets, pictures, and leaflets pertaining to Piper planes and aviation.

Berkley Models, Inc., Brooklyn, New York
Catalog and handbook for model planes, boats, and race cars.

BUILDING MATERIALS

Armstrong Cork Company, Lancaster, Pennsylvania
Booklets on cork, linoleum, etc., for floors, walls, insulation, and other uses.

Curtis Companies, Inc., Clinton, Iowa
"Design Book No. 505."
"Architectural Woodwork by Curtis." Write for prices.

Weyerhaeuser Sales Company, St. Paul 1, Minnesota.
Booklet, "The High Cost of Cheap Construction."

Masonite Corporation, 111 West Washington Street, Chicago 2, Illinois
Booklets on Masonite products and their uses.

United States Gypsum Company, 300 West Adams Street, Chicago 6, Illinois
Booklets on Gypsum and its uses.
Sample kit of materials and products.

Johns-Manville, 22 East Fortieth Street, New York 16, New York
Illustrated descriptive booklet of building materials.

National Oak Flooring Manufacturers Association, Dermon Building, Memphis, Tennessee
Booklet on laying and finishing oak floors.

FREE MATERIALS (Cont.)

CEMENT

Universal Atlas Cement Company, 135 East Forty-second Street, New York 17, New York
Handbook of concrete construction.

Alpha Portland Cement Company, 33 West Grand Avenue, Chicago 10, Illinois
Booklets, "Concrete Handbook of Permanent Farm Construction," "The Drama of Cement Making," "A Practical Course in Cement."

Lehigh Portland Cement Company, Chicago, Illinois
Booklet on cement and concrete.

CRAFTS

Universal Handicrafts Service, Inc., 1267 Sixth Avenue, New York 19, New York
Booklets entitled "Creative Ideas."

Gaylord Brothers, Inc., Syracuse 1, New York
Booklet on book repairing.

X-Acto Crescent Products Company, Inc., New York 16, New York
Booklets on whittling and model airplane construction.

Handy and Harman, 82 Fulton Street, New York 7, New York
Booklets on silver and silver jewelry making. Write for prices.

William Dixon, Inc., 32 East Kinney Street, Newark, New Jersey
Various booklets on craft work with plans and instructions for making things in metal, plastics and wood. Write for prices.
Excellent catalog of tools and supplies for craft work free to teachers.

Woodcraft Equipment Company, Independence, Missouri
Booklet, "A Syllabus on Archery."

The Ohio Leather Company, Girard, Ohio
Booklet, "The Story of Leather," also sound film.

Tanners' Council of America 100 Gold Street, New York 7, New York
Booklet on leather and leather terminology.

DRAWING

Eugene Dietzgen Company, 2225 North Sheffield Avenue, Chicago 14, Illinois
Booklet, "Use and Care of Drawing Instruments."

American Lead Pencil Company, Hoboken, New Jersey
Samples of drawing pencils, tracing pencils, etc.
Leaflet, "How Pencils Are Made."

The Frederick Post Company, Chicago, Illinois
Wall chart showing standard architectural and engineering symbols.
Catalog of drawing instruments and supplies.

FREE MATERIALS (Cont.)

ELECTRICITY AND ELECTRICAL EQUIPMENT

Thomas A. Edison, Inc., West Orange, New Jersey
Booklet, wall chart and leaflets on Edison storage batteries.

Westinghouse Electric Company, 306 Fourth Avenue, P. O. Box 1017, Pittsburgh 30, Pennsylvania
Booklet, "Motion Pictures and Slide Films for School Use."

General Electric, Schenectady, New York
Numerous booklets on motors, electrical equipment, motion pictures, etc.

Willard Storage Battery Company, Cleveland, Ohio
Booklets on storage bateries. Battery service manual.

METAL WORKING MACHINES AND TOOLS

The R. A. LeBlond Machine Tool Company, Cincinnati 8, Ohio
Ten job sheets of lathe projects.
Booklet describing LeBlond Dual-Drive lathe.

Sheldon Machine Company, Inc., Chicago, Illinois
Book on care and operation of a lathe, 50 cents.

Nicholson File Company, Providence, Rhode Island
Book, "File Filosophy."

Kearney and Trecker Corporation, Milwaukee 14, Wisconsin
Booklets on milling machine practice.

Delta File Works, Inc., Philadelphia, Pennsylvania
Booklet on "Care and Use of Files," 10 cents.

Cleveland Twist Drill Company, 1242 East Forty-ninth Street, Cleveland 14, Ohio
Handbook for drillers.

Atlas Press Company, 1822 North Pitcher Street, Kalamazoo, Michigan
"Manual of Lathe Operation," $1.00
Wall charts of lathes and date sheets. Write for prices.

Warner and Swasey Company, Cleveland, Ohio
Booklet on the grinding of lathe tools.

South Bend Lathe Works, 425 East Madison Avenue, South Bend 22, Indiana
Booklets, charts and films on lathes and lathe operation.

MISCELLANEOUS MATERIALS AND SUBJECTS

Bethlehem Steel Company, General Offices, Bethlehem, Pennsylvania
Booklets on the making and uses of steel.

Revere Copper and Brass, Inc., 230 Park Avenue, New York 17, New York
Booklets on magnesium alloys and on radiant heating.

Electro Metallurgical Company, 30 East Forty-second Street, New York 17, New York
Booklet, "Stainless Steels and Their Uses."

The Dow Chemical Company, Executive Offices, Nidland, Michigan
Illustrated booklet on magnesium.

FREE MATERIALS (Cont.)

American Telephone and Telegraph Company, 195 Broadway, New York 7, New York
Bell Telephone System booklets available at Bell Telephone business offices.

Association of American Railroads, Washington 6, D. C.
Numerous booklets and motion pictures on railroads and rail transportation.

Plymouth Cordage Company, North Plymouth, Massachusetts
Booklets on rope and its uses.

Aluminum Company of America, Pittsburgh, Pennsylvania.
Booklet, "Aluminum, Its Story."

PLASTICS

Plaskon Division, Libby-Owens-Ford Glass Company, Toledo, Ohio
Booklets on plastics and their uses.

Monsanto Chemical Company, Plastics Division, Springfield, Massachusetts
Booklets on the characteristics, fabrication and uses of plastics.

Durez Plastics and Chemicals, Inc., North Tonawanda, New York
Bulletins on the manufacture and fabrication of plastics.

The Dow Chemical Company, Midland, Michigan
Booklets on the use of plastics, illustrated in color.

SAFETY

National Board of Fire Underwriters, Chicago, Illinois
Numerous leaflets, booklets, etc., on fire prevention.

Pyrene Manufacturing Company, Newark, New Jersey
Booklet, "What You Should Know About Fire Extinguishers."

National Safety Council, 20 North Wacker Drive, Chicago 6, Illinois
Bulletins showing publications and services of this organization.

SHEET METAL

Kester Solder Company, Chicago, Illinois
Booklet, "Facts on Soldering."

The Ruby Chemical Company, Columbus, Ohio
Leaflets on materials for soldering stainless steels and methods of procedure.

The Turner Brass Works, Sycamore, Illinois
Illustrated leaflets on the care and use of the blow torch.

WELDING

International Acetylene Association, 30 East Forty-second Street, New York, New York
Numerous booklets on welding procedures and applications. Write for prices.

FREE MATERIALS (Cont.)

The Linde Air Products Company, Carbide and Carbon Building, 910 Baltimore Avenue, Kansas City 6, Missouri

Numerous booklets and leaflets covering all phases and applications of oxyacetylene welding.

Also, "The Oxyacetylene Handbook," 587 pages, complete treatise on welding and cutting, price $1.00 to schools.

The Hobart Brothers Company, Box EW-87, Troy, New York

Booklets on electric welding procedures.

Textbook, "Practical Arc Welding," a complete treatise on arc welding and the training of operators. Price $1.50.

American Welding Society, 33 West Thirty-ninth Street, New York 18, New York

Bibliography of publications relating to oxyacetylene welding instruction.

WOOD AND LUMBER

Appalachian Hardwood Manufacturers, Inc., 414 Walnut Street, Cincinnati 2, Ohio

Brochure No. 15, "Appalachian Hardwoods."

Southern Cypress Manufacturers' Association, Jacksonville, Florida

Booklets on cypress, its characteristics and uses.

American Forest Products Industries, Inc., 1319 Eighteenth Street, N. W., Washington, 6, D. C.

Booklets and charts on trees and woods.

Douglas Fir Plywood Association, Tacoma 2, Washington

Booklets on plywood and its uses.

Mahogany Association, Inc., 75 East Wacker Drive, Chicago, Illinois

Booklet "How to Identify Genuine Mahogany and Avoid Substitutes."

WOOD FINISHING

William Zinsser & Company, Inc., 319 Western Avenue, Chicago, Illinois

Booklets on the production and uses of shellac.

The De Velbiss Company, Toledo, Ohio

Booklets on spray painting equipment and its uses.

The Savogran Company, 60 West Superior Street, Chicago 10, Illinois

Leaflets on paint and varnish remover and its use.

S. C. Johnson & Sons, Inc., Racine, Wisconsin

Booklets and leaflets on finishing waxes and their uses.

WOODWORKING TOOLS AND MACHINES

E. C. Atkins & Company, Indianapolis, Indiana

Booklets and charts on saws with directions for filing, care and use.

Ohlen-Bishop Manufacturing Company, Columbus, Ohio

Booklet "Saw Efficiency" tells how to use and maintain all types of saws.

FREE MATERIALS (Cont.)

The Irwin Auger Bit company, Wilmington, Ohio
Booklet on care and use of bits.

Stanley Tools, New Britain, Connecticut
Various booklets and charts on tools, also plans of projects. Write for lists of projects plans and prices of same.

Henry Disston & Sons, Inc., Philadelphia, Pennsylvania
Booklets and charts on saws, files, etc.

Simonds Saw and Steel Company, Fitchburg, Massachusetts
Various booklets on care and use of saws and machine knives.

Heston and Anderson, Fairfield, Iowa
Descriptive circulars of woodworking machines.

Delta Manufacturing Division, Rockwell Manufacturing Company, Milwaukee, Wisconsin
Booklets descriptive of Delta machines and their operation. Separate booklets giving rather full directions for operation of the different woodworking machines, also booklets of projects. Write for price list.

Boice-Crane Company, Toledo, Ohio
Bulletins describing tools and machines.
Booklet on metal spinning, 10 cents.

Foley Manufacturing Company, 30 Second Street, N. E., Minneapolis 13, Minnesota
Circulars of saw filing and conditioning equipment.

Porter-Cable Machine Company, Syracuse 8, New York
Bulletins describing portable sanders, grinders and saws.

6. SUGGESTED MATERIALS AND SUPPLIES

The following lists may be helpful in checking and preparing budgets and orders. The items listed under "Home and Farm Mechanics" are those needed in addition to the usual materials found in woodwork, metal work, and electricity. These lists include only those materials and supplies which are most commonly needed. Many will want to include other items.

PLANNING AND DRAWING

Black and White
  Paper
  Developing fluid
Blueprint
  Paper
  Potassium bichromate crystals
Drafting Tape
Erasers
  Pencil
  Ink
File Folders
Ink, India
Paper
  Cross section, 8½ by 11 in.
  Drawing, 8½ by 11 in.
  Drawing, 11 by 17 in.
  Drawing, 17 by 22 in.
  Isometric, 7 by 10 in.
  Tracing, 36 in.
  Card board, selected sizes and plys
Paste, Paper

MATERIALS AND SUPPLIES (Cont.)

Pencil Pointers

Pencils
- 4H—Layout
- 2H—Brightening
- H—Lettering and tracing

Pens
- Points
- Holders

Stapler

Thumb Tacks

Tracing cloth—36 in.

WOODWORKING

Brads
- ⅜, ½, ⅝ in.—No. 20
- ¾, ⅞ in—No. 19
- 1 in.—No. 18
- 1¼ in.—No. 16

Brush Cleaner

Brush Holders, Rubber

Brushes
- Artists'
- Varnish, flat, 1 in.
- Varnish, flat 1½ in.
- Sash, oval ½ in.

Carbon Paper

Corrugated Fasteners

Colors—ground in oil or Japan:
- burnt umber, chrome yellow, Prussian blue, rose lake, Vandyke brown, raw sienna, burnt sienna

Dowels
- Hardwood, 3-ft. lengths, ¼, 5/16, ⅜, ½, ¾ in.

Enamel
- Selected colors
- Undercoater

Fillers—paste
- Natural, golden oak, walnut and mahogany

Fillets—leather, ¼ and ⅜ in.

Glass Cutters

Glazier Points

Glue
- Cabinet
- Casein
- Liquid
- Weldwood or Cascamite

Hardware
- Brackets, catches, corner braces, escutcheons, handles, hinges, hasps, hooks, lamp, fittings, lid supports, locks, pulls

Lacquer
- Clear and selected colors
- Thinner

Lumber
- Ash, balsa, basswood, birch, cherry, mahogany, maple, oak, poplar, red cedar, red gum, walnut, white pine
- Hardwood, for furniture, should be specified first and second grade, kiln dried, standard widths and length, or short lengths

Moldings

Nails
- Common, 6d, 8d, and 10d
- Box, 4d, 6d, 8d
- Finishing, 4d, 6d, and 8d

Oil
- Linseed, boiled
- Linseed, raw
- Machine
- Rubbing

Overlay Carvings

Panel or Plywood—⅛, ¼, ⅜, ½ in.
- Basswood, white pine, walnut, gum, maple, mahogany

Pins—escutcheon

Pumice Stone

Putty

Rottenstone

MATERIALS AND SUPPLIES (Cont.)

Rubbing Felt

Sandpaper—Garnet—
- 3/0, 2/0, 0, ½, 1
- Garnet finishing paper—6/0, 4/0
- Wet or dry finishing paper 7/0

Screws (Flathead, brass)

No. 2 x ⅜ in.	No. 6 x ¾ in.
No. 3 x ½ in.	No. 7 x ⅞ in.
No. 5 x ⅝ in.	No. 8 x 1 in.

Flathead, bright

No. 3 x ½ in.	No. 10 x 1 in.
No. 4 x ½ in.	No. 8 x 1¼ in.
No. 5 x ⅝ in.	No. 10 x 1¼ in.
No. 6 x ¾ in.	No. 10 x 1½ in.
No. 7 x ⅞ in.	No. 12 x 1½ in.
No. 8 x 1 in.	No. 10 x 1¾ in.
No. 10 x ¾ in.	No. 23 x 1¾ in.

Oval head, brass
- No. 5 x ¾ in.
- No. 7 x ⅞ in.
- No. 8 x 1 in.

Roundhead, blued

No. 3 x ⅜ in.	No. 8 x 1 in.
No. 3 x ½ in.	No. 8 x 1¼ in.
No. 5 x ¾ in.	No. 10 x 1¼ in.
No. 6 x ¾ in.	No. 10 x 1½ in.
No. 7 x ⅞ in.	No. 12 x 1½ in.

Roundhead, brass

No. 3 x ⅜ in.	No. 4 x ⅝ in.
No. 4 x ½ in.	No. 5 x ¾ in.

Phillips screws, assorted sizes

Shellac
- Alcohol
- Orange, cut 4 lb. to the gal.
- Sticks, assorted colors
- White, cut 4 lb. to the gal.

Stains—Oil and water
- Dark oak, golden oak, mahogany, and walnut

Steel Wool—0 and 2/0

Tempra Colors

Turpentine

Varnish

Flat	Spar
Gloss	Remover
Bar top	

Waste—Cotton, white

Wax—Paste

Upholstery Materials
- Springs
- Spring clips
- Cambric
- Muslin
- Burlap
- Needles
- Twine and thread
- Webbing
- Curled hair
- Moss
- Cotton bats
- Tacks
- Gimp

METAL WORKING

Abrasive Cloth
- Aluminum oxide
  - 50 yd. rolls—1½ in. wide.
  - Grit No. 120, 180, 240, 320
- Crocus cloth
  - 9 by 11 in. sheets

Abrasive Wheels
- 40 grit coarse grinding
- 80 grit for medium and fine grinding

Aluminum
- Pigs and scrap for foundry
- Sheets—16 ga., 18 ga., 20 ga.
- Selected sheets and bars

Asphaltum

Belt Dressing

Belt lacing materials

Bolts and Nuts—selected sizes
- Carriage
- Machine N.C.
- Machine N.F.
- Stove (flat and roundhead)

Brass
- Bars, ⅛, ¼, ⅜, ½, ¾ in. by 8 ft.—10 ft.
- Square
- Round

MATERIALS AND SUPPLIES (Cont.)

Sheets—12 in. wide—26 ga., 22 ga., 18 ga.
Standard and colonial
Strips—Selected sizes
Tubing—Selected sizes
Wire—Hard and soft, selected sizes
Buffing Wheels
Selected sizes
Case Hardening Compound
Coal and Coke
Copper
Sheets, soft, 32 oz., 24 oz., 16 oz.
Selected sizes
Bars or rods
Selected sizes
Tubing
Selected sizes
Wire
Core Compounds
Flour and paste
Clear Metal Lacquer
Cutting Compounds
Cutter Bits, unground—to fit holders
Die Casting Metal, for Foundry
Drill and Countersink Combination
Etching Acid (nitric)
Files
Round and half-round
Taper saw files
Flat
Needle
Warding
Mill
File Handles
Flux, for foundry metals
Hack Saw Blades
10 and 12 in. long, 18, 24, 32 tooth
Jeweler's Saw Blades
Lacquer Thinner
Lead Pigs, and Scrip for Foundry
Leather Fillets
Lighter, safety gas
Liver of Sulphur
For oxydizing art metal work
Nickel Silver
For jewelry and art metal
Oil
Linseed or fish
(for oxydizing iron)
Lubricating
Quenching and hardening
Parting Sand
Paint and Enamels
For metals
Pickeling Acid (H_2SO_4)
Pewter, selected gauges
Polishing Compounds
Tripoli
Rouge (white)
Rouge (red)
Rivets
Copper—Selected sizes
Iron—Selected sizes
(Flathead or button head)
Tinners
12 oz., 1 lb., 1¼ lb., 1½ lb., 2 lb.
Silver Solder
Solder, pewter
Solder (half and half)
Bar
Wire
Ribbon
Soldering Paste and Flux
Sal-ammoniac
1-lb. bricks
Soapstone Crayon
Steel
Band iron, hot rolled, ⅛ to ⅜ in. thick, ½ to 2 in. wide, 12-ft. lengths, selected sizes
Drill rod, letter sizes A to Z, number sizes, 1 to 80, in 3-ft. lengths, selected sizes
Bars, hexagon and spare, cold rolled, ¼ to ¾ in, in 12-ft. lengths, selected sizes
Round, cold rolled, diameters ⅛ to 1 in., lengths 12 ft., selected sizes

MATERIALS AND SUPPLIES (Cont.)

- Octagonal tool steel, selected sizes
- Sheet, black, Nos. 18, 20, 22, 24, 26, 28, U.S. gauge; size of sheets, 24, 28 and 30 by 96 in.
- Sheet, galvanized, Nos. 18, 20, 22, 24, 26, 27 and 28, U.S. gauge; size of sheets, 24, 28 and 30 by 90 in.
- Steel Wool
- Tin—sheets
  - IC, IX—20 by 48 in.
  - IXX—20 by 48 in.
- Waste, cotton
- Wax Fillets
- Welding Fluxes
- Welding Gas
  - Oxygen
  - Acetylene
- Welding Rods
  - Arc and gas
- White Lead—for machine shop
- Wire
  - Coppered spring, 12 to 18 gauge
  - Galvanized, 9 to 18 gauge
  - Stove pipe, 18 to 20 gauge

ELECTRICITY

- Armored Cable
  - 2 wire—No. 14
  - 3 wire—No. 14
  - Box connectors
- Batteries
  - Dry cells
  - Storage
- Battery Acid
- Battery Clips
- Brushes—Assorted
  - Motors
  - Generators
- Clips, Fahnestock, assorted
- Conduit
  - Bushings, ½, ¾, 1 in.
  - Connectors and lugs
  - Couplings
  - Lock nuts, ½, ¾, 1 in.
  - Rigid, ½, ¾, 1 in.
- Fixtures
- Fuses
- Lamps, assorted types and sizes
- Pipe, continuous thread, ⅜ in.
- Solder, rosin core
- Soldering Paste, non-corrosive
- Staples, insulated
- Tape
  - Friction
  - Rubber
- Wire
  - Annunciator, No. 18
  - Fixture and lamp cord, No. 18
  - Rubber covered, solid copper, Nos. 10, 12, 14, black and white
  - Magnetic, cotton or enamel covered, sizes selected
  - Nichrome resistance
  - Heater Cord, asbestos
  - Radio hookup, 20, rubber and cotton covered

CRAFTS

- Leather
  - Tooling calf
  - Tooling steerhide
  - Pigskin
  - Sheepskin
  - Embossed leathers
  - Cowhide
  - Belt strips
  - Others
- Lacing
  - Goatskin
  - Plastic
- Saddle Soap
- Rubber Cement
- Sewing Thread, linen
- Dyes and Stains
- Hardware for Leather
  - Buckles

MATERIALS AND SUPPLIES (Cont.)

- Snaps
- Key frames
- Rivets
- Plastics (plexiglas, lucite, garalin, catalin)
  - Sheets
  - Rods (round and square)
  - Cylinders
  - Other shapes
- Plastic Cement
  - Methylene dichloride
  - Others
- Metal Findings for Plastics
  - Clasps
  - Drive screws
  - Chains
  - Hinges
  - Catches
  - Others
- Scotch Tape
- Abrasives
  - Sandpaper
  - Pumice stone
  - Buffing compound
- Pottery Clay
- Kiln Shelves and Supports
- Stilts
- Pyrometric Cones (assorted)
- Glazes (ready mixed—selected colors)
- Plaster of Paris
- Kiln Wash
- Oxides
- Bookbinding Materials
  - Adhesive cloth
  - Binder cloth
  - Needles and thread
  - Glue
  - Cardboard and paper
- Tempra Colors
- Wax Crayons
- Artist's Brushes
- Yarn
  - Cotton
  - Wool
- Printer's Ink
- Carpet Warp

HOME AND FARM MECHANICS

- Aluminum Rivets and Washers
- Bolts, toggle
- Brush Cleaner
- Brushes, Paint
- Cement
- Cleaning Fluid
- Cord
  - Wrapping
  - Sash
- Crack Filler and Plastic Wood
- Faucet Washers, assorted sizes
- Glass
- Glass Cutters
- Glazer Points
- Metal Polish
- Mortar Mix
- Packing
  - Sheet
  - Rope
- Paints and Enamels
  - Household, assorted types and colors
- Paper, wrapping
- Paper Tape, gummed
- Plaster of Paris
- Plaster Patching Mix
- Plaster Stick
- Putty
- Rope, assorted sizes
- Sand
- Screen Wire
- Slacked Lime
- Weather Stripping
- Window Shades
  - Rollers and fittings
  - Shade material

MATERIALS AND SUPPLIES (Cont.)

AUTOMOBILE MECHANICS

Brake Fluid
Brushes, touch-up enamel
Cleaners
  Body
  Upholstery
  Tires
Cotter Pins, assorted sizes
Crocus Cloth
Distilled Water
Door Catch Lubricator Sticks
Enamel, automobile
Gaskets
  Copper asbestos
  Cork and felt
  Flange
Grease, selected grades
Kerosene
Keys, assorted
Lacquer and Thinner, automobile
Light Bulbs
Nuts and Bolts
  N.F. castellated, square, hexagon selected sizes and kinds
Oil
  Cylinder—selected grades
  Penetrating
Radiator
  Hose
  Hose clamps
  Flushes
  Solders
Road Maps
Shim Maps
Tow Cable
Tack and Staples, upholstery
Tire
  Tube repair stock
  Cement and patches
Valve grinding compound
Washers, assorted sizes
Waste and Rags
Waxes and Polish
Weather Stripping, automobile door
Wire
  Ignition
  General
Washing Soaps

7. A LIST OF SUPPLIERS AND MANUFACTURERS OF INDUSTRIAL ARTS EQUIPMENT AND MATERIAL

All-Steel Equipment Company
  350 John Street
    Aurora, Illinois
    Manufacturers of tool and storage cabinets.

American Art Clay Company
  4714 West Sixteenth Street
    Indianapolis, Indiana
    Anaco electric pottery kilns and ceramic supplies. Special pottery units which include all of the necessary supplies and equipment.

American Type Founders Sales Corp.
  924 Grand Avenue
    Des Moines 9, Iowa
    Manufacturers of foundry types, automatic cylinder presses, letterpress and offset presses. Handles complete printing supplies.

Atlas Press Company
  1819 N. Pitcher Street
    Kalamazoo 130, Michigan
    Dealers of lathes, drill presses, shapers, arbor presses, milling machines.

Balbach Company (The)
  1201 California Street
    Omaha, Nebraska
    Gas welding and cutting equipment.

Boice-Crane Company
  938 Central Avenue
    Toledo 6, Ohio
    Woodworking machine tools.

SUPPLIERS AND MANUFACTURERS (Cont.)

Brodhead-Garrett Company, Inc.
Cleveland, Ohio
Crafts supplies and complete line of tools and materials for wood and metal work.

Brown and Sharpe Manufacturing Company
Providence, Rhode Island
Manufacture machine tools, machinist's tools, cutters, and other machine and tool equipment.

Burgess Battery Company
180 North Wabash Avenue
Chicago 1, Illinois
General handicraft supplies and materials.

Brunstein-Applebee Company
1012 McGee Street
Kansas City 6, Missouri
Radio and electronic sets, supplies and apparatus.

Campbell, M. L., Company
708 East Nineteenth Street
Kansas City 8, Missouri
A complete line of wood and metal finishing materials.

Carmen-Bronson Corporation
162 S. Fulton Avenue
Mount Vernon, New York
Plastic supplies and materials.

Charles Bruning Company, Inc.
4700 Montrose Avenue
Chicago, Illinois
Drafting instruments and supplies, reproduction equipment and papers.

Charles A. Tolbe Leather Company
149 North Third Street
Philadelphia, Pennsylvania
Materials and tools for leathercraft.

Central Steel and Wire Company
3000 West Fifty-first Street
Chicago 80, Illinois

Cincinnati Milling Machine and

Cincinnati Grinders, Inc.
Cincinnati, Ohio
Manufacturers of machine tools.

Cleveland Model and Supply Company
4506 Larain Avenue
Cleveland 2, Ohio
Model kits for airplanes, trains, ships, cameras, gas motors, etc.

Constantine, Albert and Son, Inc.
797 East 135th Street
New York, New York
Dealers in domestic and foreign woods, lumber, veneer and plywood. General industrial arts supplies, equipment, and hardware. The Thurston "hard to get" items have been combined with this company.

Craftsman Supply House
Scottsville, New York
Plastics and crafts supplies.

Crescent Machine Division,
Rockwell Manufacturing Company
Leetanda, Ohio
Manufacturers of woodworking machinery.

Delta Manufacturing Company
600 East Vienna Avenue
Milwaukee, Wisconsin
Complete line of small power tools.

Elcraft—Educational Laboratories
1637 Court Place
Denver, Colorado
Jobbers and distributors of general craft supplies.

Eugene Dietzgen Company
521 Market Street
San Francisco, California
Manufacturers of drafting and surveying equipment and supplies.

SUPPLIERS AND MANUFACTURERS (Cont.)

Eutectic Welding Alloys Company
40 Worth Street
New York 13, New York
Manufacturers of low temperature welding rods and fluxes.

Frank Paxton Lumber Company
Des Moines, Iowa
Complete line of hardwoods and supplies.

Frederick Post Company (The)
Hamlin and Avondale Avenues
Chicago, Illinois
A complete line of drafting equipment and supplies.

Gane Bros. and Lane, Incorporated
1329-45 West Lake Street
Chicago, Illinois
Suppliers of bookbinding equipment and materials.

General Finishes Sales and Service Co.
1548 West Bruce Street
Milwaukee 4, Wisconsin

Globe Machinery and Supply Co.
East First and Court Avenue
Des Moines, Iowa
and
205 Third Avenue
Cedar Rapids, Iowa
Distributors of hand and machine tools and supplies.

Griswold Crafts Shop (The)
1100 Glen Avenue
Colorado Springs, Colorado
Designs for leathercrafts.
General Craft supplies.

Hallicrafters Company
Fifth and Kostner Avenue
Chicago 24, Illinois
Manufacturers of radio and electronic equipment.

Handicrafts, The
Waupin, Wisconsin
Handicraft supplies and materials.

Henry Disston and Sons, Inc.
Philadelphia, Pennsylvania
Dealer in tools, files, saws, knives.

Iowa Machinery and Supply Company
315-317 Court Avenue
Des Moines, Iowa
Distributors of industrial machinery and supplies.

Heston and Anderson
Fairfield, Iowa
Manufacturers of power woodworking equipment. H. & A. line is a commercial heavy duty line. "Blue Star" is a lighter line for school shops.

J. A. Fay and Egan Company
Cincinnati, Ohio
Complete line of both light and heavy woodworking machinery.

J. D. Wallace and Company
134 S. California Avenue
Chicago 12, Illinois
Woodworking machinery.

J. L. Hammett Company
Kendall Square
Cambridge 42, Massachusetts
Materials for basketry, weaving, materials, looms, and miscellaneous supplies.

Johnson Gas Appliance Company
Cedar Rapids, Iowa
Manufacturers of melting furnaces, heat treating equipment and bench furnaces suitable for the industrial arts laboratory.

Keuffell and Esser Company
516-20 S. Dearborn Street
Chicago, Illinois
Manufacturers and importers of drawing instruments and materials, surveying instruments and measuring instruments. Quality merchandise.

Latta and Sons
Cedar Falls, Iowa
General school supplies, craft supplies, and drawing equipment.

SUPPLIERS AND MANUFACTURERS (Cont.)

Lewis Machine Tool Company
P. O. Box 116, Station A
Los Angeles, California
Blueprint material covering various machine tool projects which they offer. They provide casting for making small machines in the industrial arts laboratory.

Lufkin Rule Company
Saginaw, Michigan
Manufacturers of tapes, rules, lumber rules and precision gauges.

Lussky, White and Coolidge, Inc.
65-71 West Lake Street
Chicago, Illinois
Dealers in upholstery equipment and supplies, drapery fabrics, cabinet and drapery hardware, woodworking tools and finishing materials.

Lyon Metal Products, Inc.
6008 Montgomery Street
Aurora, Illinois
Manufacturers of cabinets, racks and benches.

Marquette Manufacturing Company, Inc.
Minneapolis, Minnesota
Manufacturers of arc welding machines, equipment and supplies.

Megow's
Howard and Oxford Street
Philadelphia, Pennsylvania
Materials for model airplanes, ships, cars, trains, etc.

Metal Crafts Supply Company
10 Thomas Street
Providence, Rhode Island
Distributors of solders, enamels, metals in sheet and wire form, stones, findings and metal working tools.

Miller Falls Company
100 South Jefferson
Chicago, Illinois
Manufacturers of hand tools and gauges for both wood and metal work.

Oliver Machinery Company
Grand Rapids, Michigan
Complete line of light and heavy woodworking machinery.

Pease, C. F., Company (The)
2601 West Irving Park Road
Chicago, Illinois
Manufacturers of blueprinting machinery, blueprint paper, drafting room furniture, photographic arc lamps.

Peck, Stow and Wilcox Company (The)
Southington, Connecticut
Machines and tools for sheet metal fabrication.

Pereny Equipment Company
Columbus 8, Ohio
Manufacturers of ceramic kilns and equipment.

Porter-Cable Machine Company
Syracuse 8, New York
Manufacture precision machinery, speedmatic floor sanders, edgers, and electric hand saws, belt, disc, spindle sanders.

Ryerson, Joseph T. and Son, Inc.
Box 8000-A
Chicago 80, Illinois
This company handles one of the largest and most varied stocks of steel in the country.

Sheldon, E. H., and Company
Muskegon, Michigan
Makers of work benches, drafting tables, and general school furniture.

South Bend Lathe Works
425 East Madison Street
South Bend 2, Indiana
Manufacturers of quality back-geared screw cutting lathes.

SUPPLIERS AND MANUFACTURERS (Cont.)

Standard Battery and Electric Company
217 West Fifth Street
Waterloo, Iowa
Distributors of hand and machine tools and supplies.

Standard Electric Time Company
Springfield 2, Massachusetts
Builders of distribution and control panels; bench and wall test units and cords.

Stanley Tool Works (The)
New Britain, Connecticut
Complete line of hand and small electric tools for woodworking.

Sterling Wheelbarrow Company
Milwaukee 14, Wisconsin
Manufacturers of foundry equipment.

Tannewitz Works (The)
301-325 Front Street, N. W.
Grand Rapids, Michigan
Manufacturers of woodworking machinery, metal sawing machinery and pressed steel specialties.

Walker-Turner Company, Inc.
Plainfield, New Jersey
Manufacturers of machine tools for metal, wood and plastics.

Weidenhoff, Joseph, Inc.
4352 W. Roosevelt Road
Chicago 24, Illinois
Automotive maintenance equipment.

Western Crafts and Hobby Supplies
213 E. Third Street
Davenport, Iowa

Western Electrical Instrument Corp.
Newark 5, New Jersey
Manufacturer of quality electrical instruments.

William Dixon, Inc.
32-42-36 East Kenney Street
Newark, New Jersey
Art metal tools and supplies, block printing, leathercraft, wood carving, and model making.

Williams, J. H. and Company
117 North Jefferson Street
Chicago 6, Illinois
Manufacturer of automotive hand tools and wrenches.

Yates, American Machine Company
Beloit, Wisconsin
Quality woodworking machines.