

● Commonwealth of Kentucky ●
EDUCATIONAL BULLETIN

**INDUSTRIAL ARTS
FOR
KENTUCKY HIGH SCHOOLS**



University of Ky.
Lexington, Ky.

Published by
DEPARTMENT OF EDUCATION
BOSWELL B. HODGKIN
Superintendent of Public Instruction

ISSUED MONTHLY

Entered as second-class matter March 21, 1933, at the post office at
Frankfort, Kentucky, under the Act of August 24, 1912.

Vol. XVI

July, 1948

No. 5

INDUSTRIAL ARTS
FOR
KENTUCKY HIGH SCHOOLS



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FOREWORD

This Handbook is designed to present approved practices in industrial arts teaching, supplemented with selected lists of books, equipment, and other material. It goes without question that Kentucky high schools need the type of assistance offered by this Handbook. Teachers of industrial arts recognize that there is need for a more unified and coordinated curriculum in this important field of instruction.

Grateful acknowledgment is made to the members of the committee who prepared the Handbook:

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I believe the contents of this bulletin represent a definite step forward in industrial arts education in Kentucky. It is hoped that its publication will insure a more unified and coordinated program of industrial arts in the high schools of the state.

BOSWELL B. HODGKIN
Superintendent of Public Instruction

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Chapter I

INTRODUCTION

Industrial arts is frequently referred to as a new school subject, yet it is as old as education itself. Its form has changed markedly from time to time and in recent years the educational value has received much greater emphasis. Early educational history tells us of the place of handiwork in the educational program of the monastery. The graphic arts, stone cutting, carving and forging were common mechanical activities among the monks. The other and somewhat later form of technical training was through apprenticeship in the crafts. The chief educational agency for the middle class youth up to the nineteenth century was apprenticeship and only about the time of the Industrial Revolution did the public school seriously enter the field of technical training.

The earliest record of a publication dealing with handwork was by Joseph Moxon, January 1, 1677. This treatise dealt with the various forms of smithing, joinery, carpentry, and turning. In 1697 John Locke became the chief exponent of the idea that education should fit a boy for practical life. Jean Jacques Rousseau advocated "learning by doing" and recognized hand training as a means of mental training. While many of the lesser educational leaders of the sixteenth and seventeenth centuries experimented with teaching handwork in one form or another with objectives ranging from trade or vocational training to a means of recreation, certainly John Henry Pestalozzi was the outstanding leader of all in teaching the practical arts as a part of every child's educational career. His thoughts as to the manipulative subjects are well presented in the following quotation: "And I am more than ever convinced that as soon as we have educational establishments combined with workshops, and conducted on a truly psychological basis, a generation will necessarily be formed which, on the one hand, will show us by experience that our present studies do not require one-tenth part of the time or trouble we now give to them."¹

In our own public schools the influence of Calvin M. Woodward's efforts toward the establishment of a manual training program at St. Louis, and Dr. John D. Runkl's effort in Boston about 1877 were

¹ Roger DeGuimps, *Pestalozzi—His Life and Work*, P. 169. New York: D. Appleton & Co. 1895.

important factors. In 1879 the Manual Training High School movement started and in many cities throughout the nation a new type of educational program sprang up with practical arts as the core and by 1905 there were schools of this type operating in Chicago, Omaha, Louisville, Cincinnati, St. Paul, and many other cities. The program soon expanded to the elementary schools and with the inauguration of the junior high school in recent years, developed to a much greater degree. We find a very definite trend in the direction of an exploratory program on the junior high school level and a specific vocational or prevocational training program in the senior high school. Work in the field of industrial arts on the secondary school level will contribute greatly to the pupil's preparation for college entrance, particularly in many technical fields such as engineering. In 1940 only 30% of the white high school graduates and 19% of the colored high school graduates in Kentucky enrolled in college. Therefore, it would seem to be our responsibility to provide the rest with some definite training which will enable them to better fit into the vocational fields of their choice.

Society as we know it today is fundamentally industrial. The advent of more and more girls and women into the heavy industries, their capacities for meticulous accuracy in fields that require highly skilled performance, their qualities of endurance and quick adaptability prove to us that a complete revolution of ideas concerning the specific fields of work for men and women is definitely taking place. The public school authorities will do well to make provisions for a wider and more varied program of industrial education for both boys and girls. The industrial shops should now be opened to girls as well as boys.

Trade schools may offer courses to girls in drafting, sheet metal, machine shop, automotive mechanics, aeronautics, printing, and woodwork. Some thought should be given to the preparation of vocational rehabilitation courses for men who are in need of retraining as a result of their war experiences. These courses could be planned for employees in those fields of the light industries which do not require a great amount of physical strength and stamina. Thousands of these wounded men, whose normal strength and endurance have been destroyed by the ravages of war need a type of training during the post-war period to rehabilitate them and enable them to become self-sustaining. An enlarged and specific industrial education program through the public schools will be the solution of this important problem.

Technical training will be of great value to all young people whether their normal life work is in an industrial pursuit or not.

There is probably no classroom activity which has a greater appeal to the average child or a more far-reaching effect on his adult experiences than does his shop training.

Definition of Industrial Arts Education

Teachers are urged to keep clearly in mind the fundamental difference between industrial arts education and vocational education. Although both of these phases of education deal with the broad general field of industry, the aims and the methods of instruction are entirely different in each case. It is a serious error for one to claim that industrial arts education serves the same function as vocational education. It does not and was never intended to do so. One may as truly claim that the study of hygiene, or general science prepares a pupil for the practice of medicine as to claim that the study of industrial arts prepares him for industry. A clear definition of the two phases of industrial education is found in the following quotation:

"Industrial arts is a phase of general education designed to develop certain habits, attitudes, and abilities desirable for all citizens of an industrial civilization regardless of their vocations. It should not be confused with vocational education, which is designed to train prospective and employed workers for proficiency in vocations.

"Industrial arts is concerned with providing experiences for pupils which will aid them in understanding the industrial factors in their environment, in developing interest in modern industry, in finding desirable means of expressing their natural urge for constructive activity, and in developing good habits of attacking problems. Vocational education on the other hand, is concerned with specific training of youth and adults who have definitely chosen an occupation as their means of livelihood."²

In the preparation of the program presented in this bulletin, the committee has endeavored to observe this differentiation between the two major areas of industrial education—industrial arts and vocational-industrial education. This material is presented with the aim of assisting teachers to a better understanding of industrial arts and of providing suggestions for the improvement of instruction in the schools of Kentucky.

The purpose of this bulletin is to assist the industrial arts teachers in Kentucky to plan their program with the assurance that they are conforming to a more or less standardized practice and thus encourage the standardization of the specific learning and doing units in the various industrial art activities. No effort is being made to

² Monroe, W. S. *Encyclopedia of Educational Research*. P. 602. The Macmillan Co., New York, 1941.

limit the scope of work offered in any community and the individual school should go as far beyond the minimum proposals of this bulletin as time and equipment will permit. The material contained herein should be helpful in measuring the quantity and quality of any of the twelve shop activities for which standards have been set up. It is hoped that in the future, standards of attainment may be included for a number of other activities as the need arises. The material herein is not meant to supplant the usual course of study or shop curriculum but is solely for the purpose of enabling each of us who is interested in doing a more effective job of teaching young boys and girls technical procedures, to do a more adequate and effective piece of work with the knowledge that we are conforming to a more or less standard practice.

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Chapter II

GENERAL INDUSTRIAL ARTS OBJECTIVES

1. To develop in each pupil an appreciation of good workmanship and good design which will enable him to enjoy a finer culture as regards materials in an involved technological society.
2. To develop in each pupil elementary skills in the use of the more common tools and machines in modifying and handling materials, and an understanding of some of the more common construction problems.
3. To develop in each pupil an active interest in industrial life and in the methods of production and distribution.
4. To develop in each pupil the following habits:
 - A. The habit of an orderly method of procedure in the performance of any task.
 - B. The habit of careful, thoughtful work without loitering or wasting time.
 - C. The habit of self-discipline which requires one to do a thing when it should be done, whether it is a pleasant task or not.
 - D. Habits of safety and health.
5. To develop in each pupil the ability to select wisely, care for, and use properly the things he buys or uses.
6. To toughen the fibre of each pupil through the necessity of completing difficult tasks, thus developing desirable social attitudes and a civic-mindedness.
7. To discover aptitudes and develop interests that have significance in life work.

Industrial Arts in Relation to the Seven Cardinal Principles of Secondary Education

Health. "The first statement, taken from the original seven and adapted to this field, would indicate that through industrial arts the pupil should: (1) become better acquainted with health needs; (2) acquire better health habits; (3) be more intelligent about cleanliness and sanitation around the home; (4) learn how to conserve and gain strength and muscular control through manual activities; (5) become familiar with occupational dangers and health hazards; (6) learn occupational safety precautions; and (7) take account of personal health possibilities in the selection and pursuit of a vocation.

Fundamental Processes. "The second cardinal principle has to do with acquiring familiarity with the processes which have come to be recognized as fundamental in the school system. While education

and training in these processes is carried on to a considerable degree by means of other school subjects, still there is strong evidence that industrial arts is also a contributing factor, in that it offers: (1) innumerable situations for the application of these processes; (2) opportunities for more firmly fixing them by means of tangible relationships, particularly in arithmetical computations; (3) a necessary stimulus to many pupils not otherwise attracted to abstract fundamentals; and (4) an insight into the fundamentals in actual life outside the school. In this connection, then, industrial arts is thought of as presenting a sort of laboratory in the school where many of the fundamentals may be tried out with much the same application as will be required in later life.

Worthy and Economic Home Membership. "The statement of this third principle is simply a reminder of an essential feature of education that has always been recognized, and toward which every subject of school work has aimed to contribute, either directly or indirectly. Industrial arts has always had its share in such a contribution, and the general statement still strongly supports the belief that such work should materially assist the pupil to: (1) recognize quality, appropriateness, and value in industrial products of use in or about the home; (2) properly care for industrial products within one's possession in order to retain the fullest measure of serviceability, particularly (a) keeping in repair the common features of the modern home; (3) appreciate the skill and labor required to establish and maintain a home; and (4) develop ability and resourcefulness which will function in the accomplishment of each. It is perhaps a simpler matter to comprehend the function of industrial arts in these connections than in some of the others.

Vocation. "The mention of vocational values in connection with intermediate industrial arts always opens the way for some one to jump to the conclusion that it is vocational training. Such is not the case, however, for it appears that vocational values have been included in the seven principles underlying all secondary education. According to the theory contained therein, industrial arts should result in: (1) appreciation of the significance of vocations to the community; (2) some conception of desirable relationships between vocational groups; (3) the discovery of one's interests and probably capabilities by means of experiences in typical manipulative activities; (4) subsequent vocational selection as a result of which the individual may prepare for and enter the vocation which will best enable him to "(a) secure a livelihood for himself and those dependent on him, (b) serve society through his vocation, (c) maintain right relation-

ships toward his fellow workers, and (d) as far as possible find in that vocation his own best development"; and (5) the acquisition of skills and abilities practically and technically correct, which may serve as a foundation for later vocational training. This is a rather long-drawn-out and formidable list of vocational values, but it should be noted it does not suggest vocational training itself.

Civic and Social Education. "In the accomplishment of civic and social objectives industrial arts can probably make as much of a general claim as any of the other subjects of the curriculum, but not as specific claims as the subjects which are in the school solely for that purpose. Toward that end the principles set up would support the assumption that industrial arts should help to: (1) develop loyalty to ideals of civic righteousness as a fundamental element in all work; (2) establish habits of cordial cooperation in social undertakings, by means of group and community undertakings which involve individual contribution to the general good; and (3) realize right relationships between various vocational groups and other groups of society.

Leisure and Recreation. "The sixth principle upon which are based the fundamental objectives for secondary education has to do with another phase of life with which school work is likely to have an indefinite relationship unless specifically provided for. There is perhaps a stronger possibility for a definite tie-up with industrial arts than with many other subjects. The original statement of the principle included (1) Foster in each individual one or more special avocational interests.

"Industrial arts offers opportunity for such fostering in: (a) manipulative activities, (b) experiment, (c) special readings, (d) observation, and (e) enjoyment of the products and performances of others. In addition, toward the further realization of this principle as an objective, industrial arts may: (2) develop a love for that which is beautiful; and (3) promote a desire for that which is artistic, appropriate, and harmonious in one's surroundings. There is a broad and varied field here, the opportunities of which are sometimes disregarded by the teacher whose attention is too closely confined to technical or routine details.

Ethical Character. "The final principle mentioned as a desirable feature of all education has to do with the development of ethical character. It is probably true that all teachers will admit this is a fundamental objective to be desired in the lives of the pupils as a result of their work. Part of the original statement of this principle suggested the development of valuable personal traits. More specif-

ically, industrial arts may contribute toward the development of character in such traits as: (1) habits of industry; (2) responsibility for a task; and (3) ethical integrity of the worker as shown in the finished product. This principle of education, in connection with any of the subjects of school work furnishes excellent beginnings for varied flights of thought and expression, but causes some difficulty when it comes to specific application of proof."¹

¹ Dea M. Schweickard—Industrial Arts in Education

Chapter III

ORGANIZATION AND ADMINISTRATION

IMPORTANCE. Industrial arts embraces multiple problems of organization and administration that are seldom found in the academic subject. New problems are arising constantly and programs are continually undergoing change to keep pace with the times. The importance of administration is well stated in a bulletin from the Office of Education:

Because of its dynamic nature, its development in a school system should be the responsibility of some individual with a sound educational background, a familiarity with modern industrial practices and developments, a philosophy of life broad enough to interpret the present social order, and an ability to present the case of industrial arts whenever an education program is under consideration.¹

How the problems of administration are met will vary with the many types of school systems. In small schools the responsibility will naturally lie with the industrial arts teacher. It will then behoove the school administrator to choose a teacher who is capable of achieving the desired results. In large systems, the supervisor will assume administrative control working directly with or under the superintendent or his assistant.

TEACHER QUALIFICATIONS. Great stress must be placed on the importance of the teacher in carrying out these necessary administrative duties. Certain qualifications are desirable if the industrial arts teacher is to meet the many problems of administration, instruction, supervision, and the like.

Certainly he must possess an educational background and personality comparable to other teachers in the system. He should demonstrate ability to teach and manifest a genuine interest in youth. In addition to these, the Missouri Industrial Arts Handbook states the following as being necessary special qualifications:

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.

¹"Industrial Arts—Its Interpretation in American Schools", Bulletin No. 34, United States Department of the Interior, Office of Education, Washington, D. C., 1937.

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 projects, and to design shop projects which are structurally sound and aesthetically pleasing.
6. A sense of neatness and orderliness with respect to shop house-keeping.²

TYPES OF SHOPS. Three distinct types of industrial arts shops are now in operation. They are: (1) the composite general shop; (2) the general shop in a major area; (3) the unit shop. The composite general shop provides pupils experiences in a number of different industrial activities carried on simultaneously in one room under the direction of one teacher. The general shop in a major area is one in which the subject experiences are confined to one field of industry, such as woodwork, metalwork, etc. This shop provides a general training on a rather broad basis in one field. The unit shop is confined to a single phase of one field of industry, such as cabinet-making or carpentry in the woodworking field, typesetting or presswork in the printing industry. This type of shop is usually found in the trade schools. It is too limited in its scope for satisfactory use in an industrial arts program.

TIME ALLOTMENT AND CREDIT. Considerable variation exists in the amount of time given to industrial arts in the public schools of Kentucky. Time allotments range from one to ten forty-five minute periods per week, with some schools offering five sixty-minute periods. The State Curriculum Committee urges the adoption of five standard periods per week as the standard for the industrial arts program.

Schools not now using the sixty-minute period may find it rather difficult to conform to this recommendation. Until such administrative changes can be made so as to make possible this type of organization, it is suggested that the shorter periods be doubled even if it necessitates the offering of the various courses on alternate days. The time saved in daily periods allotted for roll call, announcements, clean up, tool check, etc., will offset a great deal of the loss of time due to less frequent periods.

Colleges and universities vary so widely in their requirements in the matter of credits that it would be practically impossible to determine what specific credit should be given for any course in industrial arts that would meet the requirements of all institutions of higher learning. This committee urgently recommends that industrial arts

² "Industrial Arts Handbook", Bulletin 7B, Secondary School Series, State Dept. of Education, Jefferson City, Mo., 1945.

be placed upon the same credit basis as other school subjects. This recommendation is made as a result of an investigation of trends in other states.

SIZE OF CLASSES. Great confusion exists regarding the number of pupils to be enrolled in any one class. This confusion is the result of the variances in shop space, equipment and pupil work stations provided. These variances exist not only in different communities but sometimes between shops within the same building. Wherever shop facilities are inadequate to accommodate the number of pupils scheduled for academic classes, one safe rule to follow is this: "The number of pupils in any industrial arts shop should never exceed the number of work stations provided."

A minimum of fifty square feet of floor space should be provided in the workshop for each pupil. This space is to include the areas allotted for tools, library, finishing and storage rooms, supply cabinet and other auxiliary rooms attendant thereto. This specification in itself should provide a basis for determining the number of pupils to be accommodated. This need not be considered as a hard and fast rule, but may well serve as a suggestion for the planning of future shops.

COSTS. The cost factor is probably the greatest element affecting the development of industrial arts in the smaller and poorer school districts.

Some of the fears of administrators concerning the cost of supporting a program are unfounded, since it has been discovered that, excluding the initial expense for equipment, the per-pupil cost of instruction is only twenty per cent above the average of academic subjects. Summary of a recent survey reveals the following:

1. The general impression that industrial arts is an expensive subject is unjustified in view of the findings of such cost studies as have been made.
2. The cost of industrial arts depends chiefly upon the local organization, enrollment, salaries, and other factors that are merely phases of the local situation. The cost of industrial arts education does not vary from other subjects as the result of characteristics peculiar to this subject only. In any well administered program the cost is comparable to that of any other laboratory course. In fact, industrial arts and other forms of industrial education will pay the community dividends in a happier, more successful, and more useful citizenry.

SHOP ORGANIZATION. Modern industrial arts laboratories and shops involving the use of tool and supply items, industrial machines and auxiliary equipment of various types, present problems of organization and supervision not present in earlier days. Increased teacher-pupil loads have added to the complexity of these problems.

In order to cope with this problem, industrial arts teachers have been compelled to develop a student personnel organization whereby students, under the direction of selected leaders, are assigned a considerable portion of routine duties, allowing the instructor more time to devote to instruction. At certain intervals the assignments should be shifted so that all students will have an opportunity to assume positions of responsibility and leadership. This plan has proven its worth educationally to students and has been so successful in relieving the teacher of numerous duties that it is now considered a vital phase of efficient school shop management.

The type of personnel organization to be employed will vary somewhat in different types of school shops. The personality of the teacher, size and nature of classes, number of activities engaged, and kind and arrangement of equipment must be considered.

The number of student officers selected and their duties will depend upon the type and size of shop, as well as the character and number of students in classes. The following list of officers, along with the duties of each, may be helpful to industrial arts teachers in organizing student personnel program :

1. Shop Superintendent
 - A. Responsible for the overall operation of the student personnel program.
 - B. Supervises assistants and reports any discrepancies to the teacher.
 - C. Calls class to attention when directed.
 - D. Gives signal for clean-up at end of period.
 - E. Inspects all stations and reports to teacher.
 - F. Trains his successor before being relieved.
2. Assistant Shop Superintendent
 - A. Assists the superintendent in every way possible.
 - B. Assumes full responsibility when the superintendent is absent.
 - C. Familiarizes himself with all the duties and responsibilities of the superintendent.
 - D. Succeeds the superintendent when shifts are made.
3. Shop Secretary
 - A. Checks class roll and records absences and tardiness.
 - B. Checks absence excuse slips.
 - C. Checks shop records.
 - D. Checks bulletin board, reference materials, etc.
4. Tool Foreman
 - A. Checks out tools to students.
 - B. Checks in tools and reports those missing or needing attention.
 - C. Responsible for condition of tool room and/or tool cabinets.

5. Stock Foreman
 - A. Issues stock to students as needed.
 - B. Assists students in selecting stock wisely and economically.
 - C. Keeps a running inventory of stock.
 - D. Reports when low limits are reached.
 - E. Responsible for the condition of stock storage.
6. Safety Engineer
 - A. Familiarizes himself with safety rules and practices.
 - B. Searches for safety hazards and corrects or reports them to the superintendent or his assistant.
 - C. Inspects safety features of tools, machines and other facilities.
 - D. Checks clothing of students that appears to be unsafe—loose sleeves, ties, etc.
 - E. Stops or reports irregular conduct of students that might create a safety hazard.
 - F. Keeps first aid kit in order and administers first aid treatment in minor cases.
 - G. Constantly strives to promote safety throughout the shop.
7. Clean-up Foreman
 - A. Checks condition of each area at the beginning of the class period.
 - B. Checks to see that each student in the shop is familiar with and successfully carries out his clean-up assignment.
 - C. Checks to see that all areas of the shop are properly cleaned before class leaves.
 - D. Responsible for storage and condition of cleaning facilities.

TOOL STORAGE. The problem of storing, distributing, and checking tools is one that concerns every industrial arts teacher and supervisor. How this is done may well affect the efficiency of instruction and operation of the shop.

The following points should be studied and evaluated when selecting a system for tool arrangement in the school shop.

1. Provisions should be made to permit maximum use of each tool with a minimum duplication of equipment.
2. Tools should be arranged so that students will be able to secure them quickly and with minimum interference and congestion in the shop.
3. An arrangement should be devised to permit quick and accurate inspection by the teacher and/or his assistant.
4. The arrangement should provide adequate protection from theft, rush, and excessive heat.

Several methods of storing and checking tools are used. Some of the more common systems, together with their advantages and disadvantages, follow:

1. The toolroom. This plan requires an enclosed room or area within or adjacent to the shop, from which tools are checked out and in by a clerk who maintains a record of each tool issued to and returned by students. This system is efficient for keeping up with tools, and it reduces losses. The toolroom system is

probably one of the best means of familiarizing the student with the proper names of tools in that he must properly identify each tool before it is issued to him. It is time consuming, however, and may cause considerable congestion at the beginning and end of the class period.

2. The open tool panel. This system is very convenient and allows tools to be secured quickly with minimum congestion. This plan, when properly organized, permits a quick inventory by the instructor. Tools are not protected against loss, especially after class hours.
3. Enclosed floor or wall cabinet. This plan provides almost as much security as the toolroom and is very convenient. It is economical of space and is easy to check.
4. Portable tool cabinet or rack. These are especially adaptable for automotive shops and other types of work where considerable tools are required. They are also valuable in rotating general shop units. These may be rolled into a tool or store room after class to provide additional security.
5. Individual tool kits. These are convenient where it is necessary to take a standard kit of tools to a particular job as in automotive work and certain other similar activities. It is difficult to check tools with this system and there may be expensive duplication of tools.

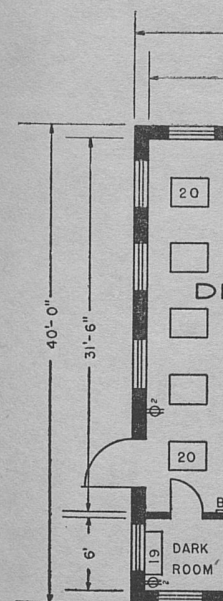
SHOP FORMS AND RECORDS. Efficient administration of a shop program requires the use of suitable records and forms to facilitate the work of: grading, ordering supplies, checking tools and supplies, checking pupil progress, cost accounting, etc. Basic forms are explained here in detail as to their requirements. Others are mentioned because of their occasional use.

1. *Inventory.* Under this heading falls the cumulative list of tools and equipment, separated in subject area groups (such as: sheet metal, machine shop, welding, etc.). The date of purchase, cost, source, name, and a brief description should be a part of this form. Yearly, and continuous supply inventories are also very necessary parts of the shop records. They should contain the description of the items, cost, amounts on hand, amounts needed, and sources of supply.

Where bidding lists are used, they could be standardized with the inventories by alphabetizing the items to be purchased. The resultant mimeographed or printed sheets could be filled in with a minimum of effort on the part of the administrator, teacher, and supply man.

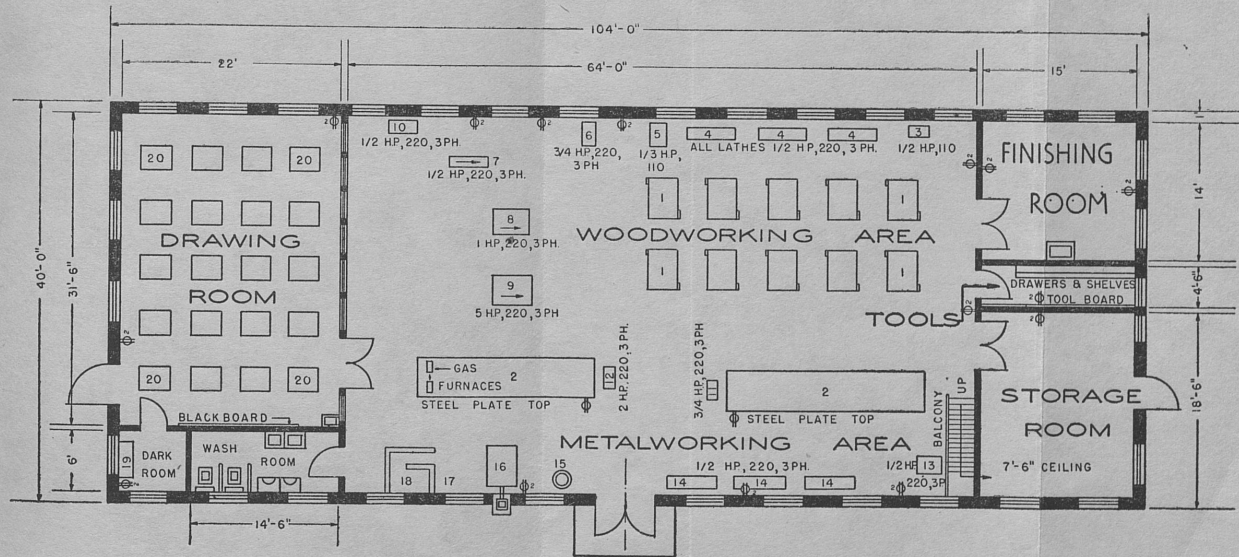
2. *Progress Chart.* This involves a cumulative record of each project or problem completed by the pupil throughout his period in the shop. It can be arranged for a semester, or longer. Usually the entire class is listed on this chart, making a semester or year record the extent of time covered. Where a period of years is concerned, a personal card for each pupil (cumulative record card) is used.

The progress chart should include: the names of all the pupils arranged alphabetically, title of the course, a year, a list of the units



1. Woodworking
2. Metalworking
3. Grinder
4. Woodturning I
5. Jig Saw

PROPOSED COMPREHENSIVE GENERAL SHOP



- | | | | |
|-------------------------|-----------------|--------------------------|---------------------------|
| 1. Woodworking Benches | 6. Band Saw | 11. Drill Press | 16. Forge |
| 2. Metalworking Benches | 7. Jointer | 12. Grinder | 17. Oxy-Acetylene Welding |
| 3. Grinder | 8. Variety Saw | 13. Shaper Metal | 18. Arc Welding |
| 4. Woodturning Lathes | 9. Surfacers | 14. Engine Lathes | 19. Blueprint Machine |
| 5. Jig Saw | 10. Shaper Wood | 15. Melting Furnaces Gas | 20. Drawing Tables |

to be learned, or a list of problems to be completed, with appropriate squares for checking and/or grading. Some provision for indicating the time expended in covering any one series of units or projects will be of help. Needless to say, the possibilities of such a chart are unlimited, but simplicity will be more apt to insure its effectiveness. The teacher should remember that this chart is intended to supplement the use of the regular class record book.

3. *Class Record Book.* This is the orthodox tabulation of attendance, progress, and grading that is furnished to the administrator. It should contain alphabetical lists of absences, test grades, project grades, and averages all grouped under the class heading for that course. Usually the teacher is furnished with standard record books, but various methods are used to accommodate this information.

4. *Shop Record.* This is usually an individual card form catalogued alphabetically in a file provided for that purpose. It should contain the record of payments, projects, chargeable supplies, hardware, etc., pertaining to pupil cost. Provision should be made for the pupil's name, age, grade, course, and semester.

5. *Cumulative Record.* A less common, but none the less important form supplements the progress chart mentioned above. It provides a condensed record of the development and background of each pupil. One such form in use contains the following items suggestive of its purpose:

- a. Name, age, address, father's occupation, etc.
- b. Classification, course, shop courses taken previously, occupational interests, etc.
- c. Scores on standardized tests, special aptitudes demonstrated, unusual personality traits, etc.
- d. Other matters pertinent to the student's personal educational, and occupational adjustment.

Additional forms not widely used, but applicable to some situations include:

- a. Time slips—daily record of pupil time.
- b. Material slip—record of materials needed for any project.
- c. Assignment sheet—daily or weekly assignment to machines, duties, responsibilities, etc.
- d. Tool loan card—record of out-of-shop tool use.
- e. Machine permit—slips issued by the teacher or foreman for machine operation. Some schools require parental approval on these slips.
- f. Hall pass—pupil permission to carry out some necessary errand elsewhere in the school.

These, and the standard forms can be made available to any school by the use of the mimeograph, hektograph, ditto or multigraph

machines. Where possible, the supplying of printed forms is recommended.

SAFETY. Probably no instruction, gained from the school shop, will have more carry-over value than that given to the safe use of machines and equipment, at the same time, helping prevent needless, embarrassing accidents in the shop which, though infrequent, are numerous enough to cause the formulation of state legislation and procedure for school boards.

The Missouri Handbook classified the causes of shop accidents under the following headings:

1. Conditions of room and equipment.
 - a. Poor lighting.
 - b. Improper location of machines.
 - c. Unguarded belts, pulleys, gears, leadscrews, cutters, etc.
 - d. Floors, passage ways, and stockrooms littered with scraps.
 - e. Dull tools and machines.
 - f. Unguarded switches.
 - g. Pushers, jigs, or guards not used.
2. Inefficient instruction.
 - a. No thought to safety; too much taking chance.
 - b. No machine permit.
 - c. Small boys allowed to operate machines.
 - d. Boys allowed to play.
 - e. Overtime work without supervision.
 - f. No thought to proper attitude.
 - g. Failure to check faulty machines.

To combat these accidents, it is imperative that adequate supervision be maintained at all times. It is necessary that the teacher present adequate, safe machine operating instructions to all students permitted to use machines; provide proper safeguards for all machines; schedule periodic safety discussions; make available safety charts; signs, and facts; require learners to secure operating permits from the teacher and/or foreman, also require parental "OK" on these permits; ban conversation by or to the operator of a machine; forbid "horseplay" in all areas of shop; and encourage the wearing of suitable clothing for safe operation of machinery.

When accidents occur, first-aid treatment should be immediately provided by the teacher, school nurse, or doctor. If one, or both, of the last two named are available, they should be given full charge of all treatment because of the advantage gained of sterility, specialized knowledge, and first-aid equipment at hand. Needless to say, all shops should have a readily accessible first-aid kit. Particularly is it necessary for schools having no nurse or doctor in full-time attendance.

Finally, it is advisable to keep an accurate record of all accidents, their treatment and causes. This will serve to provide measures of preventing future accidents of like nature, and will serve as case history in dealing with serious accidents. In this latter sense, a bulletin entitled, "Teacher Liability for Pupil Injuries,"³ will aid in answering the legal questions of the harrassed teacher or administrator, in whose shop has occurred a serious mishap.

³ "Teacher Liability for Pupil Injuries", and other safety bulletins may be secured from the National Education Association, 1201 16th St., N.W., Washington, D. C. (A small charge is made for these bulletins.)

Chapter IV

PLANNING AND EQUIPPING THE SCHOOL SHOP

Conforming to Objectives. There should be a thorough understanding of the objectives to be realized before shop planning is attempted. The needs of the community and the modern trend of industrial arts must be ascertained. For wise planning it is imperative that courses be organized and learning units established. This enables one to know what is to be taught. Progress may then be made toward planning the shop and selecting the equipment. Too many shops are built and equipped before any serious thought is given to objectives or course content. Inadequate and costly shops are frequently the result of such erroneous planning.

Who Should Plan. Few architects understand all the problems involved in school shop planning. Therefore, it is of vital importance to consult teachers on such problems. Industrial supervisors, administrators, and institutions of higher learning are always happy to assist.

Meeting Community Needs. Shops should be planned to meet future as well as present needs. Select equipment that is modern and durable. Money is never saved by the purchase of tools and machines that will be worn out or become obsolete within a few years. Neither is it economical to install expensive equipment that might well be replaced by that which is less expensive yet just as adequate.

Location. Shops may be located in a separate structure or in a wing of the regular school building. A separate shop building may be of cheaper construction and can often secure lower insurance rates, but unless the central heating system is used the final cost may not be lower. It is generally more satisfactory to have it located under the same roof, but in a wing with a department that will not be disturbed by the noise that escapes.

Shops should be located above the ground level. Damp and poorly lighted basement rooms should be condemned as a place for our boys and girls to develop skills that involve a high degree of accuracy. Woods cannot be worked satisfactorily in a damp location and metal stock and machinery rust.

First floor locations are better because heavy equipment, bulky lumber and stock are easier to move into the shop.

Size. Most shops cannot be wider than standard classroom width which is approximately 24 feet. Sometimes this may be increased by locating the shop at the end of the wing and utilizing a part of the corridor. This may be done when it does not cause congestion or interfere with fire regulations. A minimum of fifty feet should be allowed for the length of most shops in addition to auxiliary rooms such as planning, finishing and storage. The size of any shop should be determined by the number of students it is expected to accommodate. Classes larger than 20 or 24 students are difficult for the average teacher to handle. A minimum of 50 square feet should be provided for each student in a shop that has largely hand work. A well equipped shop with machines should allow much more.

Shape. The shop should be rectangular shaped so that the instructor may view the whole room from any position within it.

Lighting, Natural and Artificial. The window glass area should equal at least one-fourth of the floor area. The window glass area should come within six inches of the ceiling. Precision machines should be located near windows and all benches and other machines away from the dark side of the room. Steel or aluminium sash windows are recommended.

Provide artificial light of twenty-five-foot-candle intensity. Separate lights for each machine are desirable if the shop is to be operated at night.

Semi-indirect, indirect, or fluorescent lights are recommended.

Painting. Much is being done today in the development of color schemes for schools, industry, and business. These findings and recommendations are based upon experiment and research. Several paint companies have pioneered in this field and will gladly share their knowledge with the schools. The shop will be a healthier, safer, and a more efficient laboratory in which to work if decorated according to the recommendations of specialists who have thoroughly studied the problem. The school shop should be as attractive as any other room in the building.

Power, Water, and Gas. It is best to locate the power panel for all machines in the shop, preferably in the toolroom or office. Machines should not be connected to the light circuit. Locate washing facilities and toilet within easy access of the shop. Finishing rooms and metal working areas should have sinks with both hot and cold running water. Place the drinking fountain in or near the shop. Locate an adequate number of wall outlets around the room and to a height of approximately 40 inches from the floor.

Provide gas for furnaces in all metalworking areas.

Heating and Ventilation. Provide heating facilities to maintain room temperature within the shop. Unit heaters are recommended. Recess all radiators to make room for equipment. Equip school shops with a ventilating system to carry off all fumes. This is essential for forge, foundry, welding, and finishing rooms.

Floors. Concrete floors are probably the most economical and practical since all fire-proof buildings are easily constructed with them. However, such floors increase fatigue for those standing on them for long periods of time, and tools that are permitted to fall on the floor are easily broken. Certain kinds of composition floor coverings are very desirable if a type of material is selected that will not dent or mar easily and will withstand the hard wear involved in the shop.

Ceiling. The ceiling should not be less than twelve feet; fourteen feet is better. Ceilings higher than 14 feet in ordinary school shops are a waste of space. Treat ceilings with acoustical plaster or celotex.

Walls. Use glazed tile to a height of four or five feet on all walls. The remainder may be plastered or finished with celotex.

Doors and Windows. Use double doors with double-action hinge leading from the shop to the corridor, finishing room, and storage room. A garage door to the outside will be necessary if auto-mechanics is offered. Double ventilator metal sash should be provided for all windows. Interior window sills should be installed to an angle of approximately 45 degrees.

Exhaust System. Install an exhaust system to remove shavings and dust when the building is being constructed. The down-draft type is to be preferred.

Blackboard, Bulletin Board, and Display Case. A blackboard and bulletin board may be placed together in the shop. The blackboard should be tilted outward slightly at the top to avoid glare. Locate the display case near by in the corridor. It should be recessed in the wall and well lighted.

Finishing Room. A well-lighted finishing room should adjoin the shop. Provide it with sink, cabinets, and exhaust system if a spray gun is used.

Supply Room. A supply room equipped with racks and shelves is needed in every department.

Tool Room. Locate the toolroom centrally and equip it with a check window, shelves, racks, and drawers for supplies.

Planning Room and Library. A planning room and shop library is highly desirable for the preparation of plans and use of reference material. The instructor may have his desk here. It should adjoin the shop and be separated by a glass partition.

Shop Arrangement

Locating Areas. Consider the relationship of certain areas when planning. For example: Welding, forge and foundry are so-called "hot metal" areas and are located together. Place the machine shop where there is excellent light. The auto-mechanics and metalworking may be located in the same section of the shop.

Bench Areas. Remove bench areas from most power machines. It is a good plan to have all dangerous power machines located in the same general area with adequate working space for each machine. Lathes, jig saws, and grinders may be located nearer the benches.

Tool Centers. Place the tool centers in the most accessible area of the shop. Locate tools on panels or in cases in their particular areas. For example, place all sheet metal tools in one area of the panel, the woodworking tools in another area, etc.

Planning. If an adjoining planning room and library are not available, then the shop should have a designated area with facilities for reference work and planning. The teacher may locate his desk here if he does not have an office.

Assembly Area. Leave a large open area in the shop for assembling. Locate it so as not to interfere with bench or machine work. Avoid placing the assembling area behind dangerous machines. A large sturdy bench with a steel plate top will prove very useful. It will aid in leveling furniture projects and provide a surface from which glue may be easily removed.

Storage Space and Lockers. Provide storage space for each student. Deep lockers are often placed along the darkest wall. Cabinet benches with doors provide excellent storage and utilize otherwise wasted space. Balconies are sometimes placed over the finishing and supply rooms for storing projects in shops with high ceilings.

Locating Machines. Woodworking machines should be located so that stock may be properly routed. Place circular saws so that no student is working behind them. Engine lathes must be located where the light is good. Locate each machine so that stock of maximum length may be safely processed.

Fire Extinguishers and First Aid. A fire extinguisher and hose should be installed in a prominent place. First aid cabinets are a part of every well-planned shop.

Equipment

Factors in Selection of Equipment.

1. Objectives to be realized.
2. Courses to be taught.
3. Course content.
4. Present and future needs of community.
5. The size of classes.
6. The grade level and maturity of students to be taught.
7. Funds available.
8. The size and location of shops.

Quality, Size, and Type. Only machines and tools of the highest quality should be purchased. Inferior products will not stand the wear and tear of student use. People do not tend to appreciate things that are cheap and inferior.

Many schools have made a mistake in purchasing machines that are entirely too small for an industrial arts laboratory, while others have spent huge sums on heavy production equipment that was not needed. There is manufactured a line of machines which may be called the medium type. This line is ideal for most school shops.

Great care should be exercised in the selection of machines. Anything lighter than the machines called the "Industrial Lines" manufactured by a number of companies should not be selected.

All machines should be individual units. Combination machines are impractical and unsafe for the school shop. Each machine should have an individual motor with direct drive or a well-guarded and efficient belted drive. The vee type belt is by far the most desirable of the belted drives.

Safety Devices. Safety devices are of great importance when selecting machines for the school shop. Such items as belt guards, enclosed gears, enclosed moving parts, and overload switches are mandatory. Many machines are manufactured with all safety devices incorporated in their construction.

Specifications and Ordering. After decisions have been made to purchase certain tools and machines, specifications must be written. It is important that every particular be given about each tool and machine so that the quality desired may be secured. The specifications

must be carefully written for all motors, giving the voltage, phase, cycle, type of current, horse power, and R. P. M.

Several copies of the orders should be prepared and competitive bidding required. Inform all bidders that the equipment is for educational purposes, thus securing a discount often allowed schools. Request the delivery date from each firm.

When bids are submitted, check them carefully to see that they conform to specifications. Do not accept substitutes unless specification standards are met.

Carefully inspect all equipment when delivered. Inform the company at once regarding any irregularity or damage to machines or tools.

The plans shown herewith are submitted purely as suggestions for these types of shops.

Chapter V

THE SELECTION, PREPARATION AND PRESENTATION OF SUBJECT MATTER

After the Industrial Arts teacher has decided upon his objectives, the type of program to be offered, and organized his shop, he is ready to plan and launch the program to attain these objectives. The three most important steps in planning the program are as follows:

1. Analyzing the task to determine the experiences and information to constitute the program and permit the attainment of objectives.
2. Arranging the experiences and information into effective teaching units.
3. Preparing instructional materials in order that teaching may be most effective.

Analyzing the task. The first step in analyzing the task is to select the industrial fields to be included in the program. These fields should be those represented in the area or the fields in which the majority of the students are interested. In strictly rural communities, activities of a worthwhile nature about the home or farm should be included.

After the fields have been selected a study of the experience and information requirements in each will reveal the elements most contributory to success. In another part of this bulletin the experiences and information of basic importance to some of the principal industrial fields may be found. If the instructor will consult these lists while analyzing the chosen fields he will find that they contain most of the important elements in each field. It is important to bear in mind that in selecting the elements to constitute the course the maturity and interests of the students, the shop facilities, and the ability of the instructor must be determining factors. Having done this, the instructor will have a list of the things the student should be able to do and the things he should know. Needless to say, no instructor should select objectives he cannot attain, teaching elements he cannot teach, or units that will be of little or no interest to his students.

As the last step in analysis it is necessary to select the elements from the lists that will contribute most to the attainment of objectives. The resulting lists will contain manipulative skills, principles, laws, information, procedures, and factual material.

Arranging the teaching units. The second step in planning the program is the arranging of the previously selected elements into teaching units based on the procedure involved in giving instruction. To accomplish this it is necessary for the instructor to select projects that meet the seven following conditions: First, the projects should involve some of the elements previously listed. Second, they should be of genuine interest and value to the group for whom they are intended. Third, they must be within the capacity of the student yet difficult enough to offer a challenge. Fourth, they must be suitable to existing shop conditions. Fifth, they should have some intrinsic value in the community. Sixth, the students should be able to complete them in a reasonable time. Seventh, they should embody good design. In some situations it is advisable that these projects be considered as "Suggested Projects" and the students allowed to select projects containing the same or similar elements.

On the basis of the projects selected and the elements involved it is now possible for the instructor to arrange these elements in order of relative importance and frequency of use. In general all manipulative and informational elements should be grouped in order under the headings, "What the student should be able to do," and "What the student should know," respectively. From this arrangement the instructor may now develop his teaching units (course of study) in the order in which they will be required.

Figure A. shows an analysis and the arrangement of the elements that might be selected as representative of the skills involved in sheet metal work. Notice that the instructor may tell at a glance the nature of the elements he must teach and the order in which they should be taught. The form also lists the information topics that are included in the unit.

Preparing instructional materials. The last step in planning the program is the preparation of instructional materials in order that teaching may be most effective. The term instructional materials as used here includes such devices as lesson plans, lesson outlines, instruction sheets, charts, maps, diagrams, pictures, blue prints, models, mock-ups, films (slide, strip, sound, and silent) and all other sensory aids to teaching.

The truly efficient and effective teacher never attempts to present a subject to his class without some form of instructional material at hand. This may be only a lesson plan and lesson outline (or a combination of both). Nevertheless he knows that regardless of his years of experience it is possible for him to forget parts of the material he has planned for the class. In addition the outline makes continuity of presentation possible.

Lesson plan. Prior to meeting each class the instructor should list the topics he intends to cover, whether they be informational or demonstrational in character. Under each topic he should also list the important points in order that nothing may be omitted.

Unit in Sheet Metal Work

What the student should be able to do:	Projects:				What the student should know:
	Utility box	Funnel	Quart Cup	Ash Tray	
1. Read a working drawing.	x	x	x	x	1. Sheet metal tools, names and parts.
2. Make out a bill of material.	x	x	x	x	2. How to care for tools and equipment.
3. Plan the procedure for the job.	x	x	x	x	3. How to identify sheet metals.
4. Measure and layout with a rule.	x	x	x	x	4. How sheet metals are produced.
5. Develop and layout rectangular forms.	x				5. Sizes and shapes of sheet metals.
6. Cut sheet metal with snips.	x	x	x	x	6. The composition of sheet metals.
7. File sheet metal edges.	x	x	x	x	7. The kinds of solders and their uses.
8. Clean sheet metal.	x	x	x	x	8. Fluxes and their use.
9. Form sheet metal with hand tools.	x	x	x	x	9. Occupational information, including requirements, opportunities, and conditions in the industry.
10. Hem-sheet metal.	x				
11. Drill holes in sheet metal.	x				
12. Rivet sheet metal.	x				
13. Prepare cut acid flux.	x	x	x		
14. Clean, tin and care for an electric soldering iron.	x	x	x		
15. Solder sheet metal.	x	x	x		
16. Develop and layout conical forms.		x			
17. Fold and set a lock seam.		x	x		
18. Use a wiring machine to wire an edge.		x	x		
19. Use stakes in forming sheet metal.		x	x		
20. Develop and lay out cylindrical forms.			x		
21. Roll a sheet on a roll former.			x		
22. Burr with a machine.			x		
23. Make a setting down seam by hand.			x		
24. Bead with a machine.			x		
25. Raise or bump sheet metal in a form.				x	
26. Anneal Copper.				x	
27. Give a hammer finish to copper.				x	
28. Chase a design in copper.				x	
29. Polish copper.				x	
30. Apply lacquer finish.				x	

Figure A.

The following lesson plan is given as an example. This particular lesson plan is intended for use with a class entering the shop for the first time on the first day of school.

Lesson Plan

FIRST CLASS MEETING

Before the class arrives:

1. Prepare student information cards.
2. Be sure tools and equipment are in perfect condition.
3. Have all tools and materials ready for the first demonstration.
4. Prepare to explain the purpose and nature of the course. Have projects ready for display.
5. Plan safety program.
6. Visualize the class as completely as possible.
7. Prepare to be happy to see the class arrive.

After the class arrives:

1. Introduce yourself to the class.
2. Pass out information cards. (These cards are to be filled out and returned to the instructor in order that he may become better acquainted with his students.)
3. Explain purpose and nature of course and shop procedure. (Display projects made by previous classes, or yourself.)
4. Tour shop and briefly explain purpose of equipment.
5. Discuss safety in the shop and explain safety procedures that will apply to the class.
6. Ask if students have any questions.
7. Assign student lockers and work stations.
8. Pass out Job Assignment Sheets and explain their use.
9. Demonstrate the first operation. (Steps of demonstration should be listed.)
10. Pass out material and start class to work.

NOTE: 1. The above 10 steps should require no more than 30-35 minutes.

2. Discipline in the shop is not mentioned because it should not be brought up until its need is apparent. Rules of conduct should then be developed by the class with the instructors guidance.

Lesson outlines. Lesson outlines refer mainly to the outlines used in presenting informational material to the class. A lesson outline may be a part of a lesson plan. This outline presents the main topics and the items included in each topic and is used to remind the instructor of each item and to maintain the continuity of the presentation.

Instruction sheets. Instruction sheets is the term used to include the Operation Sheet, Information Sheet, Job or Informational Assignment Sheet, and the Job Sheet.

The Operation Sheet presents the steps involved in performing a specific operation and is titled "How to Sharpen a Drawing Pencil,"

"How to Grind a Bevel Edge Tool," etc. A decade or two ago very little information was available in this form. Today a great variety of very satisfactory operation sheets are available in book or manual form and the need for the instructor's writing this type of material is limited to special operations.

The Information Sheet presents selected information on a subject and is usually titled, "How Nails Are Made," "The Story of Iron," "The Requirements, Opportunities, and Working Conditions in the Foundry," etc. Information Sheets are also available today in printed form, however, it is sometimes necessary for the instructor to prepare Information Sheets on special subjects that are not available in printed form.

The Assignment Sheet may take the form of a Job Assignment Sheet or an Informational Assignment Sheet and is concerned with assigning the student to a particular job or to the task of reading a reference, visiting a factory or in some other manner gaining information on his own accord. They are usually titled, "To Make a Utility Box," "To Visit an Industrial Drafting Room," etc.

Very few good assignment sheets are available in published form, therefore it remains for the instructor to prepare his own. In the present day shop and especially the Composite General Shop, or Laboratory of Industry, the proper use of assignment sheets can change the instructors teaching task from one of drudgery to one of pleasure and result in teaching efficiency never before dreamed of.

Job Assignment Sheets are prepared after the instructor has selected the elements and the projects for a course. The sample Job Assignment Sheet in Figure B. illustrates its form. The Sheet presents the job in its entirety. The numbers in the parentheses following the learning units and steps of procedure refer to the pages in the listed references that describe the operation or procedure. Where adequate references are not available the term demonstration is inserted to designate the steps the instructor is to demonstrate.

With these sheets in use it is possible for individuals to progress at their own rate; the instructor is relieved of the burden of repeating countless demonstrations and is free to supervise his class more closely; and in addition he is relatively certain that every member of his class experiences the manipulative activities he has selected as most important.

NAME OF SCHOOL

Industrial Arts
Department

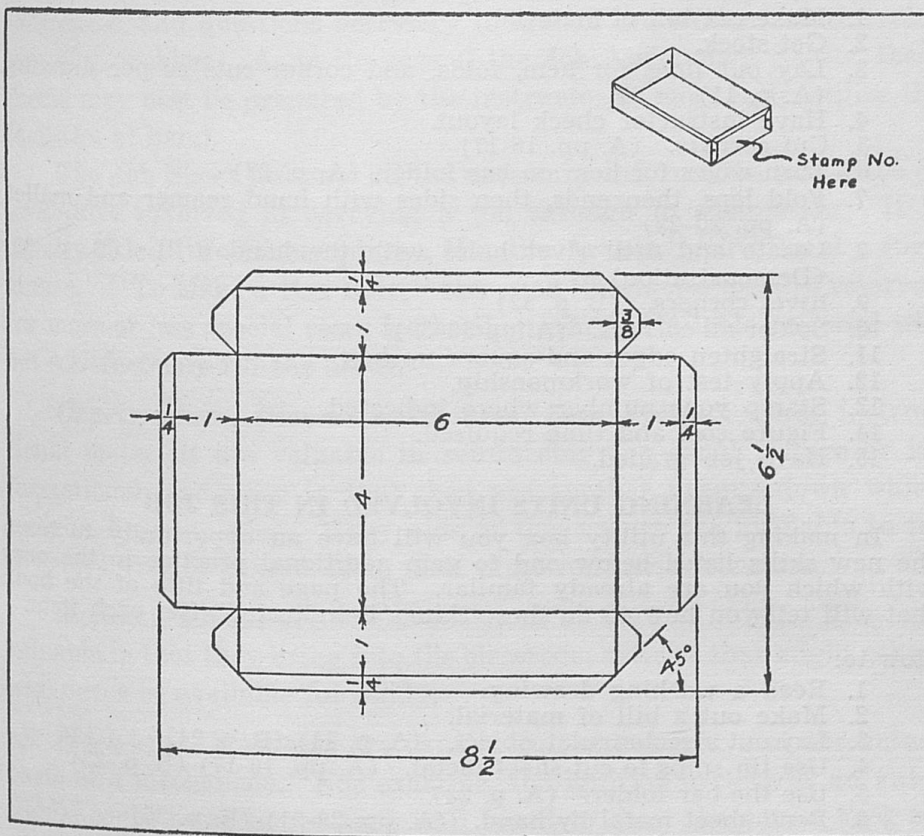
Job No.

Date

JOB ASSIGNMENT: TO MAKE A UTILITY BOX

Student's Name

Specifications: To be made of 28 gauge sheet iron. Each corner to be fastened with one 1-lb. rivet. Hem edge $\frac{1}{4}$ ".



Student's Job Plan

Before you start to work on this project read this job plan carefully, and estimate the time you will need to complete the job. Then follow the "steps of procedure" listed below, checking each step as you complete it. This will save you time, labor, and material, and will result in a better job.

Estimate time required to do job..... Actual time.....

Cost of job.....

Bill of Material

No. of Pieces	Finished Size	Kind of Material	Name of Part
1	6½" x 8½"	28 gauge iron	Box
4	#1 lb.	rivets	Fasteners

Steps of Procedure:

1. Make out bill of material.
2. Get stock.
3. Lay out lines for hem, folds, and corner cuts as per drawing. (A. p. 11)
4. Have instructor check layout.
5. Cut corners. (A. pp. 16-17)
6. Turn edges for hem on bar folder. (A. p. 23)
7. Fold laps, then ends, then sides with hand seamer and mallet. (A. pp. 20-22)
8. Locate and drill rivet holes with the hand drill. (B. p. 32) (Demonstration)
9. Rivet corners. (B. p. 32)
10. Solder all corners. (A. pp. 36-39)
11. Straighten edges and square up box.
12. Apply test of workmanship.
13. Stamp your number where indicated.
14. Figure cost and time required.
15. Have job graded.

LEARNING UNITS INVOLVED IN THIS JOB

In making this utility box you will have an opportunity to learn the new skills listed below and to gain additional practice in the ones with which you are already familiar. The page and title of the book that will tell you how to do these things is indicated after each item.

How to:

1. Read a working drawing.
2. Make out a bill of material.
3. Lay out a rectangular object. (A. p. 11) (B. p. 24)
4. Use tin snips to cut sheet metal. (A. pp. 16-17) (B. p. 25)
5. Use the bar folder. (A. p. 23)
6. Bend sheet metal by hand. (A. pp. 20-21) (B. p. 26)
7. Drill holes in sheet metal. (Demonstration)
8. Use the rivet set. (Demonstration)
9. Rivet sheet metal. (B. p. 32)
10. Hem an edge by hand. (A. p. 22)

References:

- A. Smith, **Units in Sheet Metal Work**
- B. Dragoo and Reed, **General Shop Metalwork**

TEST OF WORKMANSHIP

When you have finished the job test your workmanship on the following points:

1. Are the inside dimensions as specified in the drawing?
2. Is the box true and square?
3. Does the box set level?
4. Are all the rivet heads round and the same size?
5. Is the hemmed edge even and smooth?
6. Is the surface around the rivets free of rivet set and hammer marks?

The use of the Job Assignment sheet is especially valuable in starting a new class to work in that the usual confusion is completely eliminated. As the class advances the Job Assignment Sheet may be gradually modified to the point where the student finally prepares the entire sheet after securing the instructors approval on a project of his own choice.

The Informational Assignment Sheet presents all the instructions, references, and questions necessary to launch the student on the solution of a problem. As in the case of the Job Assignment Sheets, these sheets may best be prepared by the instructor to most fully utilize the facilities at hand.

The Job Sheet presents all the necessary information and steps of procedure involved in carrying a job through to completion. It is usually titled "To Electroplate a Metallic Article," "To Build a Bird House," "To Make a Box Kite," etc. Job Sheets are usually reserved for more-or-less special cases in the shop where available material will not satisfactorily fill the needs.

Charts, Maps, Diagrams, Pictures, Blue Prints. These instructional materials are valuable in reinforcing the usual lecture or informational discussion in that they are another avenue down which to drive home an idea. Many aids of this nature are available to instructors, free of charge, from most large industrial concerns.

Models. Models are small imitations of the real thing. They are valuable in that they bring into the classroom articles that might otherwise never be available for study.

Mock-ups. Mock-ups are usually full size displays of the actual parts of a mechanism. For example, the ignition system of an automobile could be arranged on a wall board to show the actual hook-up and even the function of each part. Working aids of this type are possibly the most effective single teaching aid. The space required for storage and cost are, however, limiting factors in most shops.

Films. Films, when properly selected and judiciously used, are excellent teaching aids. Sound-motion films are probably the most

satisfactory type of training film because they present the sounds or noises as well as the accompanying action. Films are available from many sources including University and College film libraries, industries, and commercial film-renting agencies. When ordering films for class use it is important to place the order sufficiently in advance to insure delivery.

A word or two of caution should be injected into the use of training films however. Much favorable publicity has been given to the use of films and one might suspect that only good can result. To the contrary, some films are only a waste of valuable time and money in that the instructor himself might equally well demonstrate and explain the same idea in a few minutes and at no cost. Other films include too much extraneous material and thereby conceal or obliterate altogether the original intention.

Sensory Aids. The foregoing teaching aids may all be classified as sensory aids. In addition, many other aids are available to the instructor or may be easily prepared. In any event these aids are no better than the instructor who uses them. Success in their use for one instructor does not necessarily imply success for another.

Presentation of Subject Matter

When the instructor has prepared his teaching materials as previously mentioned, he is ready to begin his instructional program. This will involve the use of various teaching techniques and procedures as will result in the attainment of objectives and the mastery of the subject matter by the student.

Learning takes place only when the student has the desire and readiness to learn. The normal urge of the student on first entering the shop is to do something or to make something. If the instructor has his program well organized and has selected his projects wisely the matter of creating and maintaining a desire to learn will be accomplished. The state of readiness to learn follows the desire to learn and it is here that the techniques and methods of presentation of subject matter by the instructor either facilitate or hinder the learning process.

Before the class begins. A good start is of fundamental importance in teaching Industrial Arts subjects as many lasting impressions are made at the first meeting. To instill favorable impressions it is important that the instructor have his shop in perfect order and his instructional materials prepared and ready prior to the first class.

After the class arrives. The sample lesson plan given earlier illustrates a procedure for the first meeting of a class. By taking a little time to start the class properly much time may be saved later.

Prior to each new unit the instructor should prepare the class by giving a brief overview of the unit, explaining its connection to previous units, and in general pointing out the practical applications of the unit in the light of student interests and possible future applications.

Methods of Presentation. The demonstration, the lecture, and the discussion methods of presenting subject matter are probably the most commonly used teaching methods in existence. This does not mean that they are the best, however, it does mean that they are the easiest methods of presentation and that they fit into the program without too much effort. While these methods are valuable they are not always the most ideal. In a single class it may be necessary for the instructor to present an idea in as many as three or four different methods in order to reach every member. The majority of the members of a class usually comprehend instruction given through a demonstration, and/or discussion on the first presentation. If the instructor is capable of presenting his material by using other techniques or methods he is able to eventually reach every member of the class.

Oral instruction. Oral instruction has always been the chief teaching method in the shop despite its limitations. In general, students prefer this type of instruction because it requires less energy and attention on their part and they can place the responsibility for failing to get the idea upon the instructor. In addition the students tend to get the idea that the instructor is responsible for their learning.

Oral instruction, besides not being entirely understood, tends to fade rapidly and repetition by the instructor is the only method of refreshing the memory. Its great values lie in its use in giving brief or general instruction and in the fact that the presence of the instructor adds interest.

Written instruction. Originally school shops were publicized as escapes from books and other printed matter. With the change in shop organization the need and value of written instructions became apparent. With properly written and properly used instruction sheets the instructor may expect to realize the following:

1. A greater variety of work may be offered.
2. A saving of time in that repetitions and lengthy descriptions are eliminated.
3. Student time is saved in that he does not have to wait on the instructor.

4. Student interest is maintained in that he may advance at his own pace.
5. A simulation of industry results in that printed instructions find considerable use.
6. Increased resourcefulness in the students in that they cannot "lean" on the teacher. Increased self-reliance and the development of a sense of responsibility.
7. Greater ease in handling large classes.
8. Opportunity for closer supervision of the class.

Some limitations of instruction sheets are:

1. The instructor may substitute instruction sheets for teaching.
2. With improper supervision, materials may be wasted, tools may be used improperly, and safety may be ignored.
3. They require much outside time to prepare when ready-made sheets are not available.

In general, these limitations are the result of the inefficiencies of the instructor rather than the instruction sheets. Under close supervision it is possible for instruction sheets to greatly increase the instructors efficiency.

Demonstrations. Estimates on the amount of learning that takes place through the eyes of an individual vary from 60 to 85%. The demonstration utilizes the sense of sight to a great degree. When properly planned and executed, the demonstration is one of the most effective teaching methods. While demonstrating the "how" of an operation the instructor should include the "why" in order that he may utilize the demonstration technique to its fullest advantage.

In general, there are two types of demonstrations. The group demonstration is used to give instruction that is needed by a certain group or the entire class. The individual demonstration is used when it is necessary to help an individual student concerning some operation or problem. Both types are necessary and important methods of instruction.

To give a demonstration most effectively the following principles should be observed:

1. There should be a need for the demonstration.
2. The demonstration should be planned in advance and all necessary tools and materials arranged for ready use.
3. Arrange students so they can see and hear.
4. Face and talk to the students.
5. Explain purpose of the demonstration and develop interest.
6. Advise students of the important points to look for in the demonstration.
7. Explain new terms and parts.
8. Supplement demonstration with visual aids whenever possible.
9. Use the tools and materials the class must use and hold demonstrations to level of students.
10. If written instructions are used follow them completely.
11. Perform operations skillfully and at correct pace.
12. Ask questions during demonstration to test understanding.

13. Avoid giving correlated and unrelated material. Truly related material may be included if it is important to clarity in the demonstration.
14. Encourage students to ask questions.
15. Stress safety.
16. Select students to aid with the demonstration when possible.
17. Form connections with previous and future lessons if possible.
18. Summarize key points.
19. Refrain from holding up the progress of the group for a few.
20. Opportunity should be provided for immediate application of instruction.
21. Follow-up and check on effectiveness of the demonstration.

Training Films. Training films, to be most effective, require some preparation on the part of the instructor. After the film has been selected the following principles should be observed.

1. Films are to be used aids, not substitutes for the instructor.
2. Do not use a film when more effective methods may be used.
3. Guard against the possibility of the student thinking of the film as an entertainment feature. In mentioning the film to the class refer to it as a part of the lesson rather than as a **show**. They should understand that the film is intended to help them learn.
4. Films should be scheduled as they fit into the course.
5. Always preview a film before using it to determine if the content is satisfactory.
6. Make a lesson plan for use when presenting the film. This lesson plan should include the following:
 - a. Lesson title
 - b. Objectives of presenting film
 - c. Time required for lesson
 - d. Other teaching methods and devices to supplement the film
 - e. Means of securing student interest and participation
 - f. Explanations of new terms in film
 - g. List of important points for students to look for in the film
 - h. Summary points
 - i. Methods of testing students
 - j. Assignments
 - k. References
7. Provide seats where all may see.
8. Set up and focus the projection before the class arrives.
9. Make certain the room is properly ventilated and darkened.

After the class arrives:

1. Prepare the students for the film by advising them of the important points to look for.
2. Present the entire film to provide an overview of the content.
3. Review the important points in the film.
4. If necessary re-run the film, or parts thereof, for clarification.
5. Test students on understanding.

The Field Trip. The most effective method of developing an understanding and appreciation of industry is by means of visits into industries. No other training device or method is comparable to the field trip for this purpose for none can simulate all the conditions that actually exist in industry.

In order that the field trip may be educationally worthwhile, it must be carefully planned. The class must be made to realize that the

trip is a part of their regular school work. In conducting a field trip the instructor should observe the following principles:

1. There should be a need for the field trip.
2. Secure approval of both school and factory administrations.
3. Request a conference with a factory representative in order that the trip may be planned most effectively.
4. Prepare the students for the trip by advising them of the important points to look for and explaining the conduct and procedure for the trip.
5. Small groups should travel through the plant separately so that all may see and hear.
6. In first class after the trip review the important points and test for understanding.

Chapter VI

MECHANICAL DRAWING

Mechanical drawing is considered in this unit to be a part of general education. For this reason the unit is planned to introduce elements from all of the main phases of mechanical drawing. Machine, architectural, structural, sheet metal, furniture, aviation, map, chart, and pictorial drawing are all introduced.

Much stress is laid upon the informational side of drawing in addition to the acquisition of skills. This is the part of drawing which is least interesting and it usually will be slighted unless it is definitely planned.

From such a source, a good student will acquire skills and information which will aid him if he should later enter drafting as an occupation, but such aid is incidental and is not the purpose of the course. The purpose of the unit is to give the student a broad understanding of mechanical drawing, "the language of industry," so that he may be able to read that language and better understand the industrial civilization in which he lives.

This unit covers work for four semesters beginning with the ninth grade or with the first year of the three-year senior high school. For each of these semesters the work is planned for five one-hour periods per week. The amount and type of work planned will also require a limited amount of preparation outside of class. Where the time allotment varies, the amount of work taught will have to be varied accordingly.

As conditions vary from school to school, it is not intended that all students should have four semesters' work in mechanical drawing, nor that the work be limited to that amount in technical high schools which are able to offer more. It is intended, however, that a student who has completed a certain number of semesters in mechanical drawing at any high school in the state shall have had approximately the same training as one who completes the same amount of work in any other high school in the state.

An introductory or exploratory unit is also outlined for use in junior high schools. Such a course should be offered only in the eighth or ninth grades and preferable only after some shopwork has been given.

Some students will take only one semester of mechanical drawing whereas others may take two, three, or four semesters, therefore the course is organized so that various phases of drawing are touched upon briefly in the first and second semesters and again more fully in the third and fourth. In this way a student who completes only one or two semesters should secure a better-balanced training than he would if all the work on one phase of drawing were placed at one point in the course. Moreover, the treatment of a given type of work at several different points in the unit provides for review and more thorough assimilation.

The unit is organized in terms of Operation Units, the things which the student should be able to do; and Information Units, the things which the student should know. There is, of course, much overlapping between the two. This organization is based upon that used in the American Vocational Association's report on Improving Instruction in Industrial Arts, a revision of the AVA Bulletin on Standards of Attainment in Industrial Arts Teaching, but many of the Operation Units have been broken down into more specific ones, and the number of Information Units has been increased.

Operation Units and Information Units are listed in two groups, (1) the recommended or ideal course, which each student should try to cover, and (2) the minimum essentials which should be required for credit. Units which are not included in the minimum essentials are marked with an asterisk(*).

Problems to be drawn should be selected to illustrate certain one of the units, and the problems drawn in each semester should be carefully analyzed by the teacher to determine that they cover the minimum essentials for that semester's work.

It is not necessary for each school or each teacher in one school to use exactly the same list of problems, as the units may be illustrated by the use of various problems.

The list of suggested problems included for each semester have been planned to cover the Operation Units of the recommended course. It is suggested that wherever possible, the problems to be drawn should be familiar to the students. For instance, if there is a farm shop in the school, some drawing problems may be taken from agricultural implements, farm buildings, crop surveys, drainage problems, etc. Wherever the school has a shop of any kind, the drawing problems should be related as closely as possible to the work being done in these shops. The drawing of purely theoretical or abstract problems should be avoided. For instance, instead of the theoretical development of a cone, the drawing of a sheetmetal pattern for a simple funnel should be used; instead of the drawing of abstract

screw threads a simple machine part requiring the use of screw threads should be required.

As this course is a part of the student's general education, much stress should be laid upon the teaching of related information. The information which the student is to gain from the course should be presented as of importance equal to that of the finished drawings, without disparaging the necessity for careful and accurate workmanship.

Each drawing should be presented as a problem, not as a copy plate. The student should be given an example of a typical problem worked out, and the necessary information for the working out of several similar problems, and be required to select one of them and work it out for himself. In all cases the finished drawing should be a result of the student's own work and not a copy of a drawing made by the teacher. It is in this planning of a problem that related information may best be taught.

A good recent textbook should be used and definite assignments made for textbook reading, study of mimeographed or printed information sheets, and examination of models and commercial drawings. Much of this study should be done outside of class. The consistent use of a notebook is essential if the student is to learn much more than the drawing of plates.

In order to emphasize the importance of the related information and to determine the extent to which it has been learned, a systematic program of periodic testing is necessary.

Mechanical Drawing I

Five one-hour periods per week for one semester

OPERATION UNITS

1. Fasten the drawing paper onto the drawing board, using drafting tape or thumb tacks.
2. Sharpen the drawing pencil with knife and sandpaper.
3. Measure with the architect's scale.
4. Mark off points with the pencil.
5. Choose the necessary views of an object.
6. Plan a drawing and make a layout of the sheet.
7. Figure spacing.
8. Make freehand sketch of a simple straight-line object.
9. Sketch circles and arcs.
10. Make a complete sketch on cross-section paper, with dimensions and notes.
11. Use the T-square and pencils in making horizontal lines.
12. Use the T-square, triangles, and vertical lines and lines at all common angles.
13. Use two triangles to draw a line through a given point, perpendicular to a given line.
14. Clean and care for drawing instruments.
15. Draw, and know when to use, the different kinds of lines used in mechanical drawing; border line, visible

- edge line, invisible edge line, dimension line, center line, cutting plane line.
16. Erase pencil lines.
 17. Block out views.
 18. Make a front view and a top view, and know the relationship between them.
 19. Make a front view and an end view, and know the relationship between them.
 20. Make three views and know the relationship between them.
 21. Pencil a drawing in correct order.
 22. Draw views with hidden edges.
 23. Dimension a drawing.
 24. Use the pencil compass.
 25. Make arrowheads.
 26. Letter numerals.
 27. Lay out a title.
 28. Letter single stroke Gothic capital letters.
 29. Make drawings to scale.
 30. Check a drawing, using a check-list.
 - *31. Draw sectional views of an object and know when they are required; full sections, half sections of cylindrical objects, and revolved sections of spokes, ribs, or handles.
 32. Letter notes and specifications.
 33. Draw an octagon when the diameter of the inscribed circle is given.
 34. Draw a hexagon when the short diameter (across flats), or the long diameter (across corners) is given.
 - *35. Indicate and dimension drilled holes.
 - *36. Indicate and dimension keyway for square key.
 37. Draw a fillet (arc) tangent to two lines perpendicular to each other.
 38. Draw a line through a given point tangent to a given circle.
 39. Draw a line tangent to two circles of varying diameters.
 - *40. Crosshatch sectioned surfaces to indicate wood, cast iron, or steel.
 - *41. Make a detail of a chamfered, beveled, or other molded edge on a simple woodwork project.
 42. Draw small fillets freehand.
 43. Use conventional breaks to decrease space required or to enlarge scale used for representing long regular parts.
 44. Use 45 degree line to project from top view to end view.
 45. Project all details from one view to both the others.
 46. Make an orthographic projection from an isometric drawing.
 47. Make an orthographic projection from a model.
 48. By the use of two triangles, draw a line through a given point, parallel to a given slant line.
 - *49. Divide a line into a given number of equal parts with the scale (parallel line method).

Mechanical Drawing I

Five one-hour periods per week for one semester

INFORMATION UNITS

1. The kinds of scales used in drafting and the purpose of each.
2. Names and uses of drafting instruments.
3. How to arrange work for proper lighting and care of the eyes; how to avoid fatigue and work most efficiently.
- *4. Kinds, standard sizes, and costs, of drawing papers.
- *5. Conventional breaks and crosshatching symbols.
6. Definition and spelling of a selected list of technical words and phrases.
7. Review of fundamentals of arithmetic, particularly addition and subtraction of common fractions.
8. Review of fundamentals of geometry.
9. Principles of dimensioning.

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|---|---|
| 10. Purpose and construction of each of the projects drawn. | 13. Kinds of pencils used in mechanical drawing. |
| *11. How to take notes on technical reading. | 14. Erasers; methods of cleaning and caring for drawings. |
| 12. Occupation information; opportunities, training, etc. | 15. How to read a mechanical drawing. |

SUGGESTED PROBLEMS—FOR MECHANICAL DRAWING I

Ten plates, size $9\frac{1}{2}'' \times 12''$; each plate to be presented as a problem, to be worked out by the student. Select one problem, similar to those suggested, for each plate.

- PLATE 1. Tenon, mortise, cross-lap joint.
Topics; orthographic projection of a simple project involving vertical and horizontal lines, scale full size, dimensioning straight line objects.
- PLATE 2. Line reel, paper weight, wedge, v-block.
New topics; 30 degree and 45 degree lines.
- PLATE 3. Tent stake, door stop, adjusting block.
New topics; slant lines, scale half size.
- PLATE 4. Guide block, lathe clamp plate, hold-down clamp, spool, bushing.
New topics; circles, dimensioning of circles.
- PLATE 5. Keystone, block, cold chisel, wrecking bar.
New topics; hexagon, scale $3'' = 1'0''$.
- PLATE 6. Pen tray, letter rack, ink-bottle holder, cast iron leg base.
New topics; simple full sections, crosshatching wood or cast iron.
- PLATE 7. Flat crank, pawl, operating handle.
New topics; tangents.
- PLATE 8. Flywheel, emery wheel flange, handwheel, gear blank.
New topics; half-sections, crosshatching steel.
- PLATE 9. Riveting hammer, soldering copper, setting-down hammer, cape chisel.
New topics; octagon, small circles and tangents.
- PLATE 10. Hexagon and wrench, square box wrench, link, valve handle.
New topics; revolved sections, breaks.

Mechanical Drawing II

Five one-hour periods per week for one semester

Units listed for this and following semesters are the new ones to be taught for the first time, in addition to those already taught. The new work will of course involve review of units already studied.

Units marked with the asterisk (*) in the previous semester's work should be considered part of the minimum essentials for this semester.

Units marked with (†) are repeated because they refer to new material each semester.

OPERATION UNITS

- †1. Letter notes and specifications.
2. Use two triangles to draw a line through a given point at any common angle to a given line.
3. Figure a complete bill of materials for a small woodwork project or sheetmetal project.
4. Transfer measurements with the dividers.
5. Draw a fillet (arc) tangent to two lines not perpendicular to each other.
6. Draw a fillet (arc) tangent to a circle and a line.
- *7. Sharpen and adjust the ruling-pen and compass-pen.
- *8. Ink the line with a ruling-pen.
- *9. Ink circles and arcs.
- *10. Ink a drawing in the proper order.
- *11. Erase an ink line or spot.
- *12. Make a blueprint.
- *13. Make an ink tracing.
- *14. Make an auxiliary view.
15. Dimension an auxiliary view.
- *16. Use the irregular curve.
17. Draw a simple floor-plan, using the proper symbols and conventions.
18. Bisect an angle.
19. Draw the development of a cylinder.
- *20. Draw the development of a cylinder cut by an oblique plane.
21. Draw the development of a cone and its frustrum.
22. Draw the development of a simple irregular surface with parallel elements (cup handle, etc.).
23. Make a detail drawing.
24. Make an assembly drawing.
25. Make an isometric drawing involving only straight lines.
26. Dimension an isometric drawing.
27. Design and draw a simple woodworking project.
- *28. Draw a pentagon.
29. Obtain data, plan layout, determine scale, and draw, a simple chart or graph.
30. Make drawing using symbols for concrete, reinforcing steel, cinders and clay.
31. Draw an ellipse by trammel method, cutting plane method, method of major and minor axes, or four-center approximation.
- *32. Use a partial auxiliary view to complete a main view.
33. Dimension a simple reinforced concrete drawing.
34. Use reference numbers to refer from a detail to an assembly or to a bill of materials.
35. Estimate the cost of a simple woodworking project.
36. Use single stroke Gothic lower case to letter.
37. Draw conventional screw threads.

INFORMATION UNITS

- †1. Definition and spelling of a selected list of technical words and phrases.
- †2. Purpose and construction of each of the projects drawn.
- †3. How to take notes on technical reading.
- †4. Occupational information; opportunities, training, etc.
5. Use of charts and graphs.
6. Reinforced concrete construction.
- *7. Drawing inks.
8. Conventional forms for doors, windows, and walls.
9. How iron castings are made and why fillets are used.
10. Review of fundamentals of arithmetic; proportion, circles, triangles, rectangles, areas, volumes, decimals.
11. Weights and gauges of sheet-metals.
12. Standard wire gauges.
13. American National screw threads.

Suggested Problems for Mechanical Drawing II

Ten plates, 9½"x12". Select on problem, similar to those suggested for each plate.

- PLATE 11. Sprocket wheel, ratchet, spoke pulley.
New topics; tangents and divisions of a circle.
- PLATE 12. Taboret, footstool, fernstand, bookends.
New topics; simple assembly drawing, details, bills of materials.
- PLATE 13. Tin cup, scoop, candlestick, stovepipe elbow.
New topics; development of the cylinder.
- PLATE 14. Funnel, ventilator hood, tree guard, flower holder.
New topics; development of cone.
- PLATE 15. Concrete flower pot, tank garden seat.
New topics; structural conventions, symbols, dimensioning, scale 1"=1'0" and scale ½"=1'0".
- PLATE 16. Jig angle, angle stop, connector bracket.
New topics; auxiliary views.
- PLATE 17. Nail box, birdhouse, anchor block.
New topics; straight line isometric drawing.
- PLATE 18. One or two-room cabin, garage, rural school.
New topics; simple floor plans, conventions, symbols, dimensioning.
- PLATE 19. Machinist's jack, vise screw, clamp.
New topics; American National screw threads.
- PLATE 20. Simple chart or graph.
New topics; obtaining data, planning, chart, scale.

Mechanical Drawing III

Five one-hour periods per week for one semester

OPERATION UNITS

1. Divide a line into a given number of approximately equal parts with the dividers.
- *2. Make a black and white print.
3. Indicate finish on a simple machine part.
4. Draw two circles tangent to each other externally.
5. Use a table of decimal equivalents.
6. Draw isometric circles and arcs in all three plans.
- *7. Draw an isometric section.
8. Draw tangents to isometric circles and arcs.
9. Use all common scales in addition to those already used.
10. Make a cabinet drawing involving circles.
- *11. Make a cabinet sectional drawing.
12. Use shading lines to indicate curved surfaces in pictorial drawings.
13. Make a simple semi-mechanical perspective.
14. Draw a circle, giving the radius and two points on the circumference.
15. Make a house wiring diagram.
16. Make a radio wiring diagram.
17. Make a detail and an assembly drawing of a simple electrical project.
18. Draw U.S.S. bolts, nuts, and machine screws.
19. Draw structural rivet heads.
20. Draw standard structural steel shapes.
21. Make a simple structural steel detail drawing.
22. Use inside and outside calipers for measuring simple machine parts.
23. Use thread gauge to determine pitch of threads.

OPERATION UNITS

- †1. Letter notes and specifications.
2. Use two triangles to draw a line through a given point at any common angle to a given line.
3. Figure a complete bill of materials for a small woodwork project or sheetmetal project.
4. Transfer measurements with the dividers.
5. Draw a fillet (arc) tangent to two lines not perpendicular to each other.
6. Draw a fillet (arc) tangent to a circle and a line.
- *7. Sharpen and adjust the ruling-pen and compass-pen.
- *8. Ink the line with a ruling-pen.
- *9. Ink circles and arcs.
- *10. Ink a drawing in the proper order.
- *11. Erase an ink line or spot.
- *12. Make a blueprint.
- *13. Make an ink tracing.
- *14. Make an auxiliary view.
15. Dimension an auxiliary view.
- *16. Use the irregular curve.
17. Draw a simple floor-plan, using the proper symbols and conventions.
18. Bisect an angle.
19. Draw the development of a cylinder.
- *20. Draw the development of a cylinder cut by an oblique plane.
21. Draw the development of a cone and its frustrum.
22. Draw the development of a simple irregular surface with parallel elements (cup handle, etc.).
23. Make a detail drawing.
24. Make an assembly drawing.
25. Make an isometric drawing involving only straight lines.
26. Dimension an isometric drawing.
27. Design and draw a simple woodworking project.
- *28. Draw a pentagon.
29. Obtain data, plan layout, determine scale, and draw, a simple chart or graph.
30. Make drawing using symbols for concrete, reinforcing steel, cinders and clay.
31. Draw an ellipse by trammel method, cutting plane method, method of major and minor axes, or four-center approximation.
- *32. Use a partial auxiliary view to complete a main view.
33. Dimension a simple reinforced concrete drawing.
34. Use reference numbers to refer from a detail to an assembly or to a bill of materials.
35. Estimate the cost of a simple woodworking project.
36. Use single stroke Gothic lower case to letter.
37. Draw conventional screw threads.

INFORMATION UNITS

- †1. Definition and spelling of a selected list of technical words and phrases.
- †2. Purpose and construction of each of the projects drawn.
- †3. How to take notes on technical reading.
- †4. Occupational information; opportunities, training, etc.
5. Use of charts and graphs.
6. Reinforced concrete construction.
- *7. Drawing inks.
8. Conventional forms for doors, windows, and walls.
9. How iron castings are made and why fillets are used.
10. Review of fundamentals of arithmetic; proportion, circles, triangles, rectangles, areas, volumes, decimals.
11. Weights and gauges of sheet-metals.
12. Standard wire gauges.
13. American National screw threads.

Suggested Problems for Mechanical Drawing II

Ten plates, 9½"x12". Select on problem, similar to those suggested for each plate.

- PLATE 11. Sprocket wheel, ratchet, spoke pulley.
New topics; tangents and divisions of a circle.
- PLATE 12. Taboret, footstool, fernstand, bookends.
New topics; simple assembly drawing, details, bills of materials.
- PLATE 13. Tin cup, scoop, candlestick, stovepipe elbow.
New topics; development of the cylinder.
- PLATE 14. Funnel, ventilator hood, tree guard, flower holder.
New topics; development of cone.
- PLATE 15. Concrete flower pot, tank garden seat.
New topics; structural conventions, symbols, dimensioning, scale 1"=1'0" and scale ½"=1'0".
- PLATE 16. Jig angle, angle stop, connector bracket.
New topics; auxiliary views.
- PLATE 17. Nail box, birdhouse, anchor block.
New topics; straight line isometric drawing.
- PLATE 18. One or two-room cabin, garage, rural school.
New topics; simple floor plans, conventions, symbols, dimensioning.
- PLATE 19. Machinist's jack, vise screw, clamp.
New topics; American National screw threads.
- PLATE 20. Simple chart or graph.
New topics; obtaining data, planning, chart, scale.

Mechanical Drawing III

Five one-hour periods per week for one semester

OPERATION UNITS

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| 1. Divide a line into a given number of approximately equal parts with the dividers. | 13. Make a simple semi-mechanical perspective. |
| *2. Make a black and white print. | 14. Draw a circle, giving the radius and two points on the circumference. |
| 3. Indicate finish on a simple machine part. | 15. Make a house wiring diagram. |
| 4. Draw two circles tangent to each other externally. | 16. Make a radio wiring diagram. |
| 5. Use a table of decimal equivalents. | 17. Make a detail and an assembly drawing of a simple electrical project. |
| 6. Draw isometric circles and arcs in all three plans. | 18. Draw U.S.S. bolts, nuts, and machine screws. |
| *7. Draw an isometric section. | 19. Draw structural rivet heads. |
| 8. Draw tangents to isometric circles and arcs. | 20. Draw standard structural steel shapes. |
| 9. Use all common scales in addition to those already used. | 21. Make a simple structural steel detail drawing. |
| 10. Make a cabinet drawing involving circles. | 22. Use inside and outside calipers for measuring simple machine parts. |
| *11. Make a cabinet sectional drawing. | 23. Use thread gauge to determine pitch of threads. |
| 12. Use shading lines to indicate curved surfaces in pictorial drawings. | |

24. Use machinist's scale, combination squares, and surface gauge to measure machine parts.
25. Make complete freehand sketch of a machine part on cross section paper.
26. Dimension to limits; using decimals.
27. Make complete drawing of a machine part, following a freehand sketch.
- *28. Make a pencil tracing on tracing paper.

INFORMATION UNITS

- †1. Definition and spelling of a selected list of technical words and phrases.
- †2. Purpose and construction of each of the projects drawn.
- †3. How to take notes on technical reading.
- †4. Occupational information; opportunities, training, etc.
5. Review of fundamentals of algebra; substitution in formulas.
6. Use of data tables.
7. Structural steel shapes, methods of fabricating, riveting, welding.
8. The use of untrue projection to clarify a drawing.
9. Why different holes are marked "drill," "ream," "bore," etc.
10. The meaning of finish and where it is used.
11. A.S.A. house wiring symbols.
12. A.S.A. radio symbols.
13. Sizes, and kinds of standard bolts, nuts, and screws.
14. Limit dimensioning.

Suggested Problems for Mechanical Drawing III

Five plates, size 12"x19". Ink tracings to be made of any two plates. No inking to be done on original drawings.

- PLATE 21. Machine details.
Details of simple machine parts involving sectioning, dimensioning to limits, screw threads, finish marking, and material notes, and reference numbers.
- PLATE 22. Machine assembly.
Assembly drawing in three views of the parts detailed in Plate 21, overall dimensioning, reference numbers, bill of materials.
- PLATE 23. Pictorial drawings.
Cavalier drawing involving circles parallel to plane of projection; isometric drawing involving circles in any plane; one of the above to involve a section; thirty degree cabinet drawing of simple piece of furniture; semi-mechanical perspective of simple straight-line object.
- PLATE 24. Structural steel.
Details of a simple structural steel joint; simple girder details; typical shape sections and data table.
- PLATE 25. Electrical drawing.
Details, assembly, wiring diagram, and bill of materials for an electric buzzer, or similar device; simple radio wiring diagram or house wiring diagram; table of A.S.A. symbols.

Mechanical Drawing IV

Five one-hour periods per week for one semester

OPERATION UNITS

1. Make drawing of aircraft part involving curves.
2. Develop sheetmetal pattern involving cylinders with axes intersecting perpendicularly.
3. Develop sheetmetal pattern with axes of cylinders intersecting obliquely.
4. Develop oblique conic section.
5. Draw an end elevation of a simple one- or two-room building.
6. Draw a front elevation of a simple one- or two-room building.
7. Draw a simple property plat.
8. Indicate welded joints.
9. Draw complete assembly of a piece of cabinet work.
10. Draw sectional detail of mortise and tenon joint.
11. Draw sectional detail of drawer construction.
12. Detail turnings.
13. Make complete bill of material for a piece of cabinet work.

INFORMATION UNITS

1. Definition and spelling of a selected list of words and phrases.
2. Purpose and construction of each of the projects drawn.
3. Occupational information; opportunities, training, etc.
4. Estimating costs of simple one- or two-room building.
5. Special kinds of drawing used in aircraft design; lofting, fairing, rolled assembly drawings, zone marking.
6. Special kinds of drawing used in automotive design; precision drawing on plate glass and aluminum, Ford decimal system of dimensioning, etc.
7. Special applications of mechanical drawing in various types of shopwork; sheetmetal layout directly on the metal, cabinet full size drawings or "rods," full size hull patterns for ship building.
8. Design of simple one- or two-room building.
9. Use of simple property plats, surveying, civil engineering.
10. American Standard Fusion Welding Symbols.

Suggested Problems for Mechanical Drawing IV

Six plates, size 12"x19". Ink tracing to be made of any one plate. Pencil tracing on tracing paper to be made of any one plate. No inking to be done on original drawings.

PLATE 26. Aviation drawing.
Details and assembly of a simple flying model plane, or detail of wing section or other typical part of full size plane.

PLATE 27. Sheetmetal patterns.
Development of complete patterns for a practical sheetmetal project involving an intersection of medium difficulty, such as small flower watering can with tapered spout, oil can, or downspout connection.

PLATE 28. Furniture drawing.
Three assembly views of table or cabinet of medium difficulty; details of mortise and tenon, dowel, or similar joint construction; detail of drawer construction; detail of turned leg or other turning.

- PLATE 29. Architectural drawing.
Floor plan, front and end elevations of a garage, one- or two-room cabin, farm building or other simple structure; complete dimensions and specifications; door and window schedule.
- PLATE 30. Map drawing.
Property plate of a city block, or topographic map of school grounds or small field.
- PLATE 31. Welding drawing.
Welded girder; workbench; metal storage rack or other problem made of rolled steel shapes and fastened by welding; all welds to be indicated according to American Standard Fusion Welding code.

Mechanical Drawing for Junior High School

This unit of work is planned for one semester on the 8-A grade level

OPERATION UNITS

1. Fasten the drawing paper onto the board with tape or tacks.
2. Sharpen the drawing pencil.
3. Make full size and half size measurements with the architect's scale.
4. Mark off points correctly with the pencil.
5. Locate on the paper the necessary views of an object.
6. Make a simple sheet layout.
7. Make a freehand sketch of a simple straight-line object.
8. Sketch circles and arcs.
9. Draw horizontal lines with T-square and pencil.
10. Draw vertical lines with T-square, triangle, and pencil.
11. Draw lines with T-square and triangles, at angles of 30 degrees, 45 degrees, and 60 degrees.
12. Clean and care for equipment.
13. Draw, and know when to use, the following: border line, visible edge line, invisible edge line, dimension line, extension line, center line.
14. Erase pencil lines.
15. Block out views.
16. Draw front, top, and end views, and know their relationship.
17. Pencil a drawing in correct order.
18. Draw views with invisible edges.
19. Dimension a drawing.
20. Use the pencil compass.
21. Sharpen lead and adjust the compass.
22. Make arrowheads.
23. Letter numerals.
24. Letter single stroke Gothic capital letters.
25. Check a drawing with a check-list.
26. Dimension circles and arcs.
27. Use 45-degree line to project from top view to end view.
28. Project details from one view to another.
29. Draw a circle tangent to vertical and horizontal lines.
30. Make an orthographic projection from an isometric drawing.
31. Make an orthographic projection from a model.
32. Properly clean up and finish a drawing.

INFORMATION UNITS

1. Kinds of boards used in mechanical drawing.
2. Kinds of triangles used in mechanical drawing.
3. Kinds and sizes of T-squares.
4. How to read the architect's scale.
5. Grades and kinds of pencils and erasers.
6. Definition and spelling of common words used.
7. Review of fundamentals of arithmetic; common fractions.

8. Review of fundamental geometric terms and forms.
9. Kinds, cost, sizes, etc., of mechanical drawing papers.
10. How to arrange work for proper light and care of the eyes.
11. Principles of dimensioning.
12. Occupations related to and dependent upon mechanical drawing.
13. Kinds of drawing; orthographic, isometric, perspective.
14. How to read a simple mechanical drawing.

Suggested Problems for Junior High School Mechanical Drawing

12 plates, size 9½"x12", minimum requirement.

- PLATE 1. Sandpaper block (straight lines).
- PLATE 2. Face-lap joint.
- PLATE 3. Window support.
- PLATE 4. Paper weight.
- PLATE 5. V-block (45 degree lines).
- PLATE 6. Line reel (30 degree lines).
- PLATE 7. Door stop (slant lines).
- PLATE 8. Toy wagon wheel (circles).
- PLATE 9. Cast iron washer.
- PLATE 10. Horseshoe magnet (simple tangents).
- PLATE 11. Fernstand top (hexagon).
- PLATE 12. Nail box (assembly).

House Planning

The emphasis in this phase of mechanical drawing has been laid on the planning and background work of home construction, rather than on the drawing of plans or the actual construction itself. The ability to plan, rather than the ability to draw plans, is a main objective of house planning. The actual drawing of plans is a major objective of architectural drawing, whereas it is only incidental to house planning.

SPECIFIC OBJECTIVES

1. To provide a knowledge of the history and background of house planning and construction.
2. To provide a knowledge of accepted types of house construction.
3. To develop the ability to evaluate the common types of construction.
4. To provide a knowledge of the function and professional services of the architect.
5. To provide a knowledge of contracting procedure, property deeds, building restrictions and permits, and home financing.
6. To provide a knowledge of house planning procedure as distinguished from drafting procedure.
7. To develop the ability to read house plans.
8. To develop the ability to plan rooms and whole house units.
9. To develop the ability to select equipment and materials.
10. To provide a general basis of information for future home ownership.

OPERATION UNITS

1. Select a site.
2. Locate building on site.
3. Orient rooms and whole buildings with regard to light and air.
4. Make a plan of a room, allowing for furniture, equipment, fenestration, etc.
5. Read construction plans.
6. Read detail drawings.
7. Read specifications in connection with working drawings.
8. Draw the accepted material symbols and use them in drawing.
9. Make a preliminary house plan and several elevations in the form of a presentation sketch.
10. Make a working plan.
11. Make a working elevation.
12. Make a wall section detail.
13. Make a simple rendering of an elevation (no perspective).
14. Locate rooms under a roof (dormers, etc.).
15. Locate equipment for economy of piping, etc.
16. Measure any room and make a working sketch of it.
17. Recognize any part of a house on sight.

INFORMATION UNITS

1. A brief history of architectural forms.
2. An acquaintance with the classic orders.
3. A brief history of domestic building.
4. The meaning of standard terms, as cornice, column, frieze, architrave, and their origin.
5. The styles of homes in modern use, and their origin.
6. Historical styles and their regional suitability.
7. How to read working drawings.
8. How to read and interpret specifications.
9. Precedence of specifications over drawings.
10. Criteria for site selection.
11. Criteria for house placement.
12. Criteria for orientation.
13. Legal requirements for building.
14. How to select and employ an architect.
15. How to select and employ a contractor.
16. How to make a working sketch.
17. Procedure in making preliminary sketch.
18. Procedure in making working drawings.
19. The use and relationship of building materials.
20. The symbolism of house plans.
21. Standard practices in construction.
22. Standard door, window, and other millwork sizes and uses.
23. Room type arrangements—as "U" or "L" kitchens, etc.
24. Elements of a building.
25. Nomenclature of various types of building materials.
26. Equipment of a modern house.
27. Placement of doors and windows.
28. Planning for the family.
29. Planning for expansion.
30. Nomenclature of parts of a house.
31. How foundations are built.
32. The use of concrete in concrete products in a modern house.
33. How frame walls are constructed, and the various types.
34. How brick walls are constructed, and the various types.
35. How stucco walls are constructed.
36. How veneer-type walls are constructed.
37. How stone walls are constructed.
38. How floors are framed.
39. How partitions are framed.
40. How openings are framed, and terminology.
41. How roofs are framed.

42. How rafters are cut.
43. Types of roofs.
44. Types of equipment necessary.
45. The plumbing needs of a modern house.
46. The heating needs of a modern house.
47. The wiring needs of a modern house.
48. Paints and finishes in home building.
49. The meaning of interior decoration.
50. The relationship of building to decoration.
51. The significance of property deeds, building restrictions and permits.
52. Methods of financing homes.

Chapter VII

WOODWORKING

In preparing this course of study in woodworking it was the desire of the committee to divide it on two levels—junior and senior high school. But due to much repetition of the various learning units involved it was thought best to divide it into three groups—A, B, and C. In group A, fundamental learning units were included which are primarily essential for the beginning student to acquire, regardless of level. In group B, and C, for the most part, such operational and informational units were included which involve a greater degree of experience and knowledge in the fundamentals.

The final selection of learning units and their arrangement is left entirely to the teacher's discretion.

Special Objectives

1. Develop skill in the use of woodworking tools.
2. Provide a knowledge of characteristics and uses of wood.
3. Develop habits of planned and orderly procedures.
4. Provide training in the reading of working drawings.
5. Develop an appreciation for good design and sound construction in wood products.
6. Provide a knowledge of various kinds of hardware as used in woodworking and their application.
7. Provide knowledge of period furniture.
8. Teach the basic principles of wood finishing.
9. Develop attitudes and habits of observing safety precautions.
10. Inspire vocational and avocational interests in woodworking.

Hand Woodworking

OPERATION UNITS—GROUP A

- | | |
|---------------------------------------|-------------------------------------|
| 1. Make a working drawing. | 14. Sharpen an auger bit. |
| 2. Make out a bill of material. | 15. Use a brad awl. |
| 3. Measure with a rule. | 16. Use wood screws. |
| 4. Grind a plane bit. | 17. Drive nails. |
| 5. Hone a plane bit. | 18. Draw nails. |
| 6. Assemble and adjust a plane. | 19. Set finishing nails. |
| 7. Use a try square. | 20. Use a rip saw, a cross cut saw. |
| 8. Use a marking gauge. | 21. Use a coping saw. |
| 9. Use a face mark. | 22. Use a back saw. |
| 10. Square stock to dimensions. | 23. Use a miter box. |
| 11. Plane chamfers and bevels. | 24. Use a wood chisel. |
| 12. Lay out curves and finish curves. | 25. Sharpen a wood chisel. |
| 13. Bore holes in wood. | 26. Make a butt joint. |
| | 27. Make a dado joint. |

28. Make a lap joint.
29. Make a miter joint.
30. Make a mortise and tenon joint.
31. Plane end grain.
32. Make an edge to edge glue joint.
33. Make a dowel joint.
34. Use a doweling jig.
35. Use bar clamps.
36. Use hand clamps.
37. Mix and apply hot glue.
38. Mix and apply casein glue.
39. Sharpen and burnish a scraper.
40. Dress screw driver.
41. Set an expansive bit.
42. Prepare a wood surface for finishing.
43. Use sand paper.
44. Use a sanding block.
45. Apply stains.
46. Apply shellac.
47. Apply filler.
48. Sand between finish coats.
49. Apply varnish.
50. Apply paint and enamel.
51. Rub and polish varnish.
52. Apply wax.

OPERATION UNITS—GROUP B

53. Lay out irregular design by means of squares.
54. Form with a spokeshave.
55. Make a rubbed glue joint.
56. Adjust and use a rabbet plane.
57. Clean finishing brushes.
58. Cut a groove or a rabbet.
59. Do a simple upholstery involving webbing and rolled edges.
60. Do upholstery involving simple padding.
61. Do simple weaving in cane or rush.
62. Use a key hole saw.
63. Cut curves with a turning saw.
64. Fit hinges.
65. Put on locks.
66. Put on drawer pulls.
67. Lay out and make a dovetail joint.
68. Make and fit a drawer.
69. Fasten on a table top.
70. Cut a spline joint.
71. Cut an edge mold.
72. Apply inlay and overlay.
73. Lay out and cut a rule joint.
74. Use a Forstner bit.
75. Sharpen a saw.
76. Use a combination plane.

INFORMATION UNITS

1. Addition and subtraction of fractions.
2. Read a working drawing.
3. Standard lumber dimensions.
4. Types of hand planes.
5. Laying out tools.
6. Sizes and types of wood boring bits.
7. Sizes and types of wood screws.
8. Proper use of flat and round head crews.
9. Sizes and types of nails.
10. Uses of common woods.
11. Characteristics and habitats of common woods and their uses.
12. Composition of glues used in woodworking.
13. Composition of abrasives used in woodworking.
14. Economical use of sandpaper.
15. Planning the finish for the use it will receive.
16. Finishing abrasives.
17. Kinds of stain and their composition.
18. Uses of shellac.
19. Uses of solvents.
20. Use and composition of varnish.
21. Care of brushes.
22. Safety precautions in the finishing room.
23. Cleanliness in the finishing room.
24. Safety precautions in the use of tools.
25. Common hardware used in woodworking.
26. Removing old finishes.
27. Use of stencils.

SUGGESTED PROJECTS FOR HAND WOODWORKING

1. Bread and meat board.
2. Peg game.
3. Bird house.
4. Chinese Checker Board.
5. Desk tray.
6. Miter box.
7. Book ends.
8. Wall shelf.
9. Shoe box.
10. Plant stand.
11. Flower box.
12. Drawing board.

13. Half round end table.
14. Lawn chair.
15. Lawn table.
16. Study table.
17. Step ladder.

18. Book rack end table.
19. Porch swing.
20. Toys.
21. Tool box.
22. Lap board.

Machine Woodworking

SPECIFIC OBJECTIVES

1. Develop skill in the use of woodworking machines.
2. Develop habits of orderly procedure in routing materials.
3. Provide knowledge in the use of jigs and templates.
4. Teach safe and sound methods in machine operation.
5. Develop the habit of carefully planned procedure of work.
6. Develop the habit of self-reliance.
7. Offer opportunities to study various aspects of mass production in woodworking.
8. Teach the care of and the maintenance of woodworking machinery.
9. Develop an appreciation for the part machines play in everyday life.
10. Teach finishing by air brush methods.

OPERATION UNITS—GROUP C

Turning Lathe

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Safety rules for operating a lathe. 2. Range of work which may be done on a lathe. 3. Adjust and care for a lathe. 4. Center stock. 5. Mount work between centers. 6. Rough down with gouge. 7. Smooth with a skew. 8. Lay off pattern on piece. 9. Mark off with pencil. 10. Use cut-off tool. 11. Cut tapers with a skew. 12. Cut beads with a skew. 13. Cut concave cuts with a gouge. 14. Measure with outside calipers. 15. Measure with inside calipers. | <ol style="list-style-type: none"> 16. Make and use a template. 17. Mount work on a face plate. 18. Mount work on a screw chuck. 19. Size work on face plate. 20. Hollow out work on the face plate of screw chuck. 21. Fasten pieces together temporarily for turning. 22. Cut off stock in lathe. 23. Sand paper in lathe. 24. Apply finish in lathe. 25. Make a spindle chuck. 26. Make a set up for duplicate parts. 27. Make a hollow chuck. 28. Off center turning. |
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Jointer

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Safety rules for operating the jointer. 2. Range of work which may be done on the jointer. 3. Care for and adjust the machine. 4. Joint an edge. | <ol style="list-style-type: none"> 5. Cut a chamfer. 6. Make a spring joint. 7. Surface narrow stock. 8. Take the wind out of a board. 9. Cut a rabbet. 10. Cut tapers. |
|--|---|

Circular Saw

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Safety rules for operating saw. 2. Range of work which may be done on the saw. 3. Care for and adjust the saw. 4. Rip. 5. Cut off. 6. Cut grooves. 7. Cut dados. | <ol style="list-style-type: none"> 8. Cut tenons. 9. Cut miters. 10. Cut tapers. 11. Core boxing. 12. Resaw. 13. Use of jigs. 14. Use of safety devices. |
|---|---|

Jig Saw

1. Safety rules for operating saw.
2. Range of work which may be done on the saw.
3. Care for and adjust the saw.
4. Exterior and interior cuts.

Drill Press

1. Safety rules for operating drill press.
2. Range of work which may be done on the drill press.
3. Adjust and control speeds.
4. Use of attachments.
5. Reeding and fluting.

Band Saw

1. Safety rules for operating the saw.
2. Range of work which may be done on the saw.
3. Care for and adjust the saw.
4. Saw curves.
5. Rip.
6. Cut off.
7. Cut tenons.

The Surfacer

1. Safety rules for operating the surfacer.
2. Range of work which may be done on the surfacer.
3. Care for and adjust the surfacer.
4. Adjust for depth of cut.
5. Adjust and control feed.
6. Feed work into the machine.

Belt Sander

1. Safety rules for operating sander.
2. Range of work which may be done on the sander.
3. Care for and adjust the sander.
4. Operate sander on flat work.
5. Operate sander on curved work.

Disk Sander

1. Safety rules for operating disk sander.
2. Range of work which may be done on a disk sander.
3. Adjust fence and table for angle cuts.

The Mortiser

1. Safety rules for operating the mortiser.
2. Range of work which may be done on the mortiser.
3. Adjust and care for the mortiser.
4. Set and adjust chisel and bits.
5. Feed work.
6. Set up for duplicate parts.

Shaper

1. Safety rules for operating shaper.
2. Range of work which may be done on the shaper.
3. Care for and adjust the shaper.
4. Change and set shaper knives.
5. Shape straight edges and ends.
6. Shape curved edges and ends.
7. Hone shaper cutters.

Tool Grinder

1. Safety precautions.
2. Types of sharpening stones, their grades and uses.
3. Speeds of grinding wheels.
4. Mounting emery wheels.
5. Dressing emery wheels.

INFORMATION UNITS

1. Learn common parts of machines.
2. Types of machines.
3. Types of blades or cutter-heads available for the various machines.

4. Set machines for duplication of pieces.
5. Care for and maintenance of accessories.
6. Study of speeds.
7. History of development of machines.

Lumber

1. Learn to identify the kinds of lumber used in the community.
2. Learn the characteristics and qualities of lumber used in the shop.
3. Learn the source of lumber.
4. Study methods used in drying and seasoning.
5. Know the effect of moisture in wood.
6. Learn the nominal and actual dimensions of lumber.
7. Know how veneer and plywood is made.
8. Learn the advantages of veneered stock.

Glue

1. The kinds of glue.
2. Preparation of glue.
3. Conditions and preparations necessary for the use of glue.
4. Manufacture and cost of glue.

Nails

1. The kinds of nails.
2. The use of the different kinds.
3. The size of nails.
4. How nails are sold.
5. How nails are manufactured.
6. Size of brads and how sold.
7. Size and kinds of corrugated fasteners.
8. Size and use of clamp nails.

Screws

1. The kinds of screws.
2. The use of the different kinds.
3. How size and kinds of screws are indicated.
4. How screws are sold.

Sandpaper

1. Types of sandpaper.
2. Grades of sandpaper.
3. Grades and use of steel wool.

Furniture

1. Is the design and construction adapted to the use for which the piece is intended?
2. Are the proportions good?
3. Is it structurally sound?
4. Is it pleasing to the eye?
5. Is the finish suited to the material and the use for which it is intended?
6. From which period of furniture design does the piece belong?

Manufacture of Wood Products

1. Location of principal centers engaged in the manufacture of wood products.
2. Extent of the use of automatic machinery.
3. Possibilities of employment in the wood industry.

Suggested Projects for Machine Woodworking

1. Drawing stool.
2. Boudoir or telephone table.
3. Magazine rack.
4. Cedar chest.
5. End table.
6. Coffee table.
7. Student desk.
8. Sewing cabinet.
9. Bed.
10. Chest of drawers.
11. Card table.
12. Drawing table.
13. Kitchen cabinet.
14. Customer.
15. Picture or mirror frame.
16. Desk or floor lamp.
17. Model air plane.
18. Shoe rack.
19. Smoking stand.
20. Work bench.
21. Tool cabinet.
22. Book shelves or cabinet.

Chapter VIII

METALWORKING

For many years metalworking has been one of the important phases of American industry. Recent developments in this field have placed it foremost in importance. Due to the fact that many millions of men and women are employed in the metalworking industries, and also that the lives of many more millions are affected by the uses of metals, it is logical to expect considerable emphasis upon this phase of public education.

The program presented here includes the following phases of metalworking: sheet metal, foundry, forging, heat treating, welding, and machine shop practice.

A. Machine Shop

Since the machine shop forms the basis for the manufacture of practically all precision tools used in the production of other machines and equipment necessary for the maintenance of all industries, its importance can hardly be over emphasized. The opportunities it affords for the development of skills in dimensioning and shaping metal are unlimited. The high degree of accuracy required in successful machine shop practices contributes definitely towards the development in the pupils of a critical and analytical approach to their problems.

The program suggested herein provides for two semesters, and the projects listed provide an adequate variety from which the teacher may select appropriate assignments.

Specific Objectives

1. To provide a knowledge of basic machine and hand tools and their uses.
2. To develop skills in the use of hand tools, precision measuring instruments, and the common machine tools.
3. To develop certain habits and attitudes desired in the shop.
4. To train the student to become proficient in simple tool design.
5. To develop an appreciation for good tools, machines, and other equipment.

OPERATION UNITS

1. Lay out work, using steel scale, combination square, and dividers.
2. Measure with inside and outside calipers.
3. Measure with depth-gage.

4. Measure with micrometer calipers.
5. Locate centers with hermaphrodite calipers.
6. Grind chisels.
7. Chip by hand.
8. Cross-file.
9. Draw-file.
10. Scrape plain surface.
11. Saw with a hack-saw.
12. Dress a screwdriver.
13. Ream with hand-reamers.
14. Cut threads with hand-dies.
15. Tap holes with a hand-tap.
16. Braze a joint.
17. Remove a broken tap.
18. Remove a broken stud.
19. Lace belts with rawhide.
20. Lace belts with metal lacing.
21. Cement leather belts.
22. Maintain a forge fire.
23. Bend round or rectangular stock.
24. Draw out stock.
25. Upset stock.
26. Forge and temper lathe-tools.
27. Anneal metal.
28. Harden carbon steel by quenching.
29. Temper a cold-chisel.
30. Case-harden.
31. Rivet.
32. Fit and assemble.
33. Align and level machines, when installing.
34. Drill with a breast-drill.
35. Determine speed with a speed indicator.
36. Check with test indicator.
37. Fit by lapping.
38. Measure and test angles with a sine-bar.
39. Drive studs by hand.
40. Mark with steel stamps.
41. Mark by etching.
42. Oil shafting.
43. Install and care for line-shafting.
44. Dress emery-wheels.
45. Lay up machinery and tools.

Machine Tools

INFORMATION UNITS FOR ALL MACHINES

1. The safety rules with respect to the particular machine.
2. The type and general description of the machine, including its size, capacity, and principal uses.
3. The names and functions of the principal parts of the machine.
4. The different working speeds of the machine, and how they are obtained.
5. How the lines of power are transmitted through the machine and how the different types of motion are produced.

The Engine Lathe

OPERATION UNITS

1. Start, stop, and reverse the lathe.
2. Clean, oil, and care for the machine.
3. Grind and set the tools for a roughing cut on cast iron, wrought iron, and tool steel.
4. Grind and set the tools for a finishing cut on cast iron, wrought iron, and tool steel.
5. Grind and set cut-off tools.
6. Grind and set threading tools to center-gage.
7. Grind and set threading tools for special threads.
8. Grind and set facing tools.
9. Grind and set boring tools.
10. Determine cutting speeds required for effective work.
11. Prepare work for mounting between centers.
12. Mount work between centers.
13. Remove and replace centers.
14. Test live centers for accuracy.
15. Grind centers.
16. Test for alignment of centers.
17. Put on and remove a face-plate.
18. Mount work on a face-plate.
19. Put on and remove chuck.
20. Center cylindrical work in a chuck.
21. Center irregularly-shaped work.
22. Center hollow-ring work in a chuck.
23. Lay off lengths on work held in lathe.
24. Cut off work with a cut-off tool.

25. Do cylindrical turning, including roughing and finishing cuts.
26. Face work in the lathe with a facing tool.
27. Face work in the lathe with a round-nose tool.
28. Cut square shoulders.
29. Cut fillets.
30. Cut external National coarse threads.
31. Cut internal National coarse threads.
32. Cut acme threads.
33. Cut taper threads.
34. Cut tapers, compound rest method.
35. Cut tapers, attachment method.
36. Set over tail-stock for taper.
37. Make taper fit in the lathe.
38. Cut irregular forms with compound rest.
39. Set up a collet chuck.
40. Set up work in jigs.
41. Mount work on a Mandrel for turning.
42. Regulate speed of lathe.
43. Bore with a boring-bar.
44. Turn work with a follow-rest.
45. Turn work in a steady-rest.
46. Drill and ream in the lathe.
47. File work in the lathe.
48. Caliper work in the lathe with outside calipers.
49. Caliper work in the lathe with inside calipers.
50. Calipers work in the lathe with micrometer calipers.
51. Polish work in the lathe.
52. Knurl work in the lathe.

The Drill-Press

OPERATION UNITS

1. Start and stop the machine.
2. Clean, oil, and care for the machine.
3. Adjust speed and feed of the machine.
4. Set up and secure work on the table.
5. Set up work in the vise.
6. Set up work in jigs.
7. Lay out a hole for drilling.
8. Set over a drill.
9. Do tapping.
10. Do reaming.
11. Do counterboring.
12. Do countersinking.
13. Do spot-facing.
14. Do boring.
15. Drill oversize holes.
16. Drill cylindrical work.
17. Drill holes at an angle to a surface.
18. Drill holes to a measured depth.

The Shaper

OPERATION UNITS

1. Start and stop the machine.
2. Clean, oil, and care for the machine.
3. Adjust the stroke and speed of the machine.
4. Adjust the feed of the machine.
5. Grind and set tools for finishing cuts.
6. Grind and set tools for roughing cuts.
7. Set up work in vise.
8. Set up work on table.
9. Make a roughing horizontal cut.
10. Make a finishing horizontal cut.
11. Machine surfaces at right angles.
12. Machine angular surfaces.
13. Machine curved surfaces.
14. Machine tapered surfaces.
15. Cut V's and dovetails.
16. Cut teeth.
17. Cut T-slots.
18. Cut a key-way.
19. Adjust the shaper head.
20. Do undercutting.
21. Set up work in jigs.

The Planer

OPERATION UNITS

1. Start and stop the machine.
2. Clean, oil, and care for the machine.
3. Adjust the speed and length of stroke.
4. Adjust the feed of the machine.

- | | |
|---|-----------------------------|
| 5. Grind planer tools. | 11. Set up work in jigs. |
| 6. Set up and fasten work on the table. | 12. Set up work in vise. |
| 7. Do horizontal planing. | 13. Plane a tee-slot. |
| 8. Adjust and use the clapper-box. | 14. Plane angular work. |
| 9. Take the "rock" out of a job. | 15. Plane tapered work. |
| 10. Set up work on angle-plates. | 16. Plane a key-way. |
| | 17. Plane a curved surface. |

The Milling Machine

OPERATION UNITS

- | | |
|--|---|
| 1. Start and stop the machine. | 20. Do drilling. |
| 2. Clean, oil, and care for the machine. | 21. Do boring. |
| 3. Set up cutters on arbor. | 22. Do form milling. |
| 4. Set up end-mill. | 23. Do spiral and helical milling. |
| 5. Set up for face milling. | 24. Do taper milling. |
| 6. Do plain milling. | 25. Do direct indexing. |
| 7. Do side milling. | 26. Do plain indexing. |
| 8. Line table, vise, and work with cutter. | 27. Do differential indexing. |
| 9. Set feed-trips. | 28. Do rack milling with attachment. |
| 10. Set up work in vise and jigs. | 29. Cut grooves with a slotting attachment. |
| 11. Clamp work to table. | 30. Mill with universal attachment. |
| 12. Do profiling. | 31. Do high speed milling. |
| 13. Do routing. | 32. Do circular milling with attachment. |
| 14. Do gang milling. | 33. Mill with vertical attachment. |
| 15. Do angular milling. | 34. Cut special shapes with fly-cutter. |
| 16. Do end milling. | |
| 17. Do flute milling. | |
| 18. Do straddle milling. | |
| 19. Saw with a slitting saw. | |

The Grinder

OPERATION UNITS

- | | |
|--|---|
| 1. Start and stop the machine. | 13. Do internal straight grinding. |
| 2. Clean, oil, and care for the machine. | 14. Do internal taper grinding. |
| 3. Adjust the speed of the machine. | 15. Do face grinding. |
| 4. Grind a flat surface. | 16. Do form grinding, cylindrical. |
| 5. Grind a vertical surface. | 17. Grind straight-tooth milling-cutters. |
| 6. Do angular grinding. | 18. Grind helical-tooth milling-cutters. |
| 7. Grind slots. | 19. Grind taper-reamers. |
| 8. Grind to shoulders. | 20. Grind end-mills and side-milling cutters. |
| 9. Grind to a form. | 21. Grind form-cutters. |
| 10. Do straight cylindrical grinding, outside. | 22. Grind form-tools. |
| 11. Do taper cylindrical grinding, outside. | 23. Mount grinding-wheels. |
| 12. Do angular cylindrical grinding, outside. | 24. Dress grinding-wheels. |

The Power Hack-saw

OPERATION UNITS

- | | |
|--|-----------------------------------|
| 1. Start and stop the saw. | 3. Regulate weight of the stroke. |
| 2. Clean, oil, and care for the machine. | 4. Change blades in the machine. |
| | 5. Secure work in the saw-vise. |

6. Feed the saw into the work.
7. Saw thin stock on the machine.
8. Saw hollow stock on the machine.

INFORMATION UNITS

1. The names of tool-bits; round-nose, square-nose, side, threading, boring, and others.
2. The types of chucks and face-plates.
3. How an indicator is used.
4. The types of threads: National Coarse, "V", square, Acme, Worm, Whitworth, National Fine.
5. The meaning of pitch, lead, left-hand, right-hand, single and multiple threads.
6. The meaning of ratio between pitch and lead.
7. The proper lubricants to use in cutting threads.
8. The types of taps and dies in common use.
9. The care of taps and dies.
10. The names and uses of small hand-tools.
11. The number and letter sizes of drills.
12. The drill-gages.
13. The grades of sandpaper and emery-cloth.
14. Keys and their proportions.
15. Belt measurements.
16. The kinds of chisels; flat, cape, gouge, side, diamond-point, and others.
17. The grade of steel used in making chisels.
18. The forms of files; flat, square, round, three-cornered, half-round, taper, blunt.
19. The cuts of files, single and double.
20. The grades of files; rough, coarse, bastard, second, smooth, dead smooth.
21. The terms used with respect to files: "safe-edge", tang, heel, pitch.
22. How sizes and kinds of saws are designated.
23. The composition and grades of babbitt.
24. The reason for using babbitt bearings.
25. The composition of solder.
26. The kinds of flux and where used.
27. The grades of iron and steel.
28. Blast-furnace, open hearth, and crucible processes.
29. Hot-rolled, cold-rolled, bar, and sheet steel.
30. The making of cast-iron castings.
31. The composition of brass.
32. The standard tapers—Morse, Browne & Sharpe, Jarno.
33. How to calculate tapers and tail-stock set-over.
34. The kinds of drills: straight-shank, square, taper.
35. Drill terms: tang, shank, flute, lips, body clearance, web, heel.
36. The speeds and feeds of drills.
37. The kinds, grades, and speeds of grinding wheels.

Suggested Projects

1. Outside firm joint calipers.
2. Vise screw.
3. Center punch.
4. Scribe.
5. Machinists jack.
6. Screw driver.
7. Tap wrench.
8. Clamp.
9. Hand vise.
10. Drill press vise.
11. Hammer.
12. File handle.
13. Center square.
14. V block.
15. V block and clamp.
16. Surface gauge.
17. Machinists parallel clamp.
18. Set of solid punches.
19. Pair of parallels.
20. Beam trammels.
21. Centering bell and punch.
22. Plumb bob.
23. Square.
24. Lathe mandrel.
25. Lathe dog.
26. Milling machine jig.
27. Pair of 6" hold downs.
28. Drill point gage.
29. Center wiggler with No. 2 morse tape.
30. Tool post boring bar.
31. Plug and ring gage.
32. Toolmakers layout punch.
33. Toolmakers scratch gage.
34. Depth gage.
35. Pair of keyseating rule blocks.

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|---------------------------------------|---|
| 36. Machinists steel rule clamp. | 44. Pipe vise. |
| 37. Universal center finder. | 45. Bench drill press. |
| 38. Pocket screw driver. | 46. Bench wood lathe. |
| 39. Machinists bench block. | 47. Bench grinder. |
| 40. T-handle tap wrench. | 48. Large screw jack. |
| 41. Toolmakers steel clamp. | 49. Toolmakers telescopic jack. |
| 42. Hand reamer with straight flutes. | 50. Machinists floating center drilling tool. |
| 43. Adjustable bench table. | |

B. Sheet Metal

These courses in sheet metal were prepared for the Junior and the Senior High School levels.

Specific Objectives

1. To give the student exploratory experiences in the use of sheet metal tools and equipment.
2. To develop in each student an appreciation of high standards of workmanship and efficiency.
3. To develop skill in designing, planning, and executing a project in the field of sheet metal.
4. To provide a knowledge of metals, their sources, manufacture, properties and uses.
5. To investigate data concerning the employment, status, salaries, and opportunities for advancement of workers in the sheet metal industries.

Unit One

OPERATION UNITS

- | | |
|---|---|
| 1. Read a working drawing. | 20. Wire edges using the bar folder. |
| 2. Make out a bill of material. | 21. Wire edges using wiring machine. |
| 3. Plan your procedure. | 22. Wire a curved object on the wiring machine. |
| 4. Measure with a rule. | 23. Make a simple parallel line development. |
| 5. Check material when received. | 24. Make a simple radial line development. |
| 6. Make a dimensioned sketch. | 25. Shrink or crimp edges in a machine. |
| 7. Layout a circle with dividers. | 26. Reenforce and decorate by beading on machine and by hand. |
| 8. Mark pattern on sheet metal. | 27. Turn a burr on a circle using the burring machine. |
| 9. Cut out a pattern using straight and curved shears. | 28. Turn flange on burring machine. |
| 10. Cut out a pattern using squaring shears. | 29. Form a double seam by hand or on machine. |
| 11. Bend metal with a bar folder or hand break. | 30. Tin a soldering copper. |
| 12. Form metal in a cornice break. | 31. Finish metal by planishing, peening, painting, or lacquering. |
| 13. Make a single and double hem by hand and on machine. | 32. Locate and center punch holes. |
| 14. Form or shape metal over a stake with a wood mallet or setting down hammer. | 33. Rivet sheet metal by hand and by using the riveting set. |
| 15. Form a cylinder on the slip roll forming machine. | |
| 16. Make a lapped seam. | |
| 17. Light and operate a blow torch or furnace. | |
| 18. Solder tin plate, galvanized sheet metal, copper, and zinc. | |
| 19. Make a grooved seam with a hand groover. | |

34. Drill sheet metal and strap iron.
35. Punch holes with solid, hollow, and hand punches.
36. Cut strap iron with the hack saw.
37. Form strap iron.
38. Peen strap iron.
39. Cut threads with tap and dies.
40. Spot weld.
41. File a piece of metal.

INFORMATION UNITS

1. How to care for all tools and equipment.
2. The name, correct use of, and adjustments of all hand tools, stakes, and machines used.
3. Identification of the various kinds of sheet metal.
4. The kinds of soft solder and their uses.
5. The kinds of flux and dipping solutions and their uses.
6. The sources of iron, tin, zinc, copper, aluminum.
7. The manufacture of sheet iron, tin plate, galvanized sheet metal, copper, aluminum, and solder.
8. The standard sizes, gauge, and weight of tin plate, galvanized sheet metal, sheet iron, copper, and zinc.
9. The kinds and sizes of rivets.
10. Standard gauges of wire.
11. Standard sizes of strap iron.
12. Kinds of threads and standard sizes of taps and dies.
13. Occupational information, including employment, status of workers, salaries, and opportunities for advancement.

SUGGESTED PROJECTS

1. Letter holder.
2. Cookie cutters.
3. Doughnut cutters.
4. Garden trowel.
5. Measuring cup.
6. Scoop.
7. Ash tray.
8. Desk calendar.
9. Pencil tray.
10. Sandwich cutter.

Unit Two

OPERATION UNITS

1. Copy from a template.
2. Cut sheet metal with: straight snips, right hand cut, left hand cut, klenks aviation, squaring shears (machine), and bench shears.
3. Cut metal with double cutting shears, circle snips, hawk bill, riveter shears, circular cutting shears (machine), and Marshalltown throatless shears (machine).
4. Form metal by hand and on machines.
5. Break metal by hand and by machine.
6. Rivet metal.
7. Hand groove a piece of metal.
8. Machine groove a piece of metal.
9. Double seam by hand.
10. Double seam with machines.
11. Raise bottom seam.
12. Chisel.
13. Punch a piece of metal, hand punch machine or tool punch, center punch, and hollow punch.
14. Wire straight and cone shaped objects by hand and with the wiring machine.
15. Burr and turn metal with burring machine and by hand.
16. Elbow edge.
17. O. B. single and triple bead.
18. Crimp a piece of metal to shrink edges.
19. Drill a piece of metal by hand and machine.
20. Set down by hand and machine.
21. Sharpen a drill bit.
22. Sharpen a pair of snips.
23. Grind.
24. Gutter bead.
25. Spot weld.
26. Cut straighten, form and bend a piece of wire at right angles.
27. File.
28. Scrape.
29. Solder galvanized sheet iron,terneplate, coke plate, and charcoal tin.
30. Solder zinc, copper, brass, aluminum, monel, stainless steel, and pewter.

31. Assemble and fit.
32. Polish and clean metal.
33. Draw and develop patterns by parallel line method, radial line method, and triangulation.
34. Read blue prints for sheet metal.
35. Make the following: Pittsburgh seam, Boston seam, drive, slides and "S" slides.
36. Construct square ducts.
37. Construct ventilators.
38. Construct from square to round.
39. Read the circumference rule.
40. Install control dampers.
41. Use the air riveter.
42. Use air hammer.
43. Use aluminum rivets (aviation types).
44. Etch copper and brass.
45. Raise copper and brass.
46. Color copper and brass.
47. Hand hammer metal.
48. Chase metal.
49. Spin metal.

INFORMATION UNITS

1. The name, use and adjustments of hand tools, stakes, and machines.
2. Care of hand tools, stakes, and machines.
3. The circumference rule.
4. Recognition of the following materials, their general characteristics and uses: terne-plate, coke plate, charcoal tin, soft and planished copper, lead, stainless steel, aluminum, brass, and black iron.
5. Recognition of the following materials, their general characteristics and uses: zinc, tin, monel, hard solder, Russian iron, hot rolled pickled and annealed sheet steel and cold rolled sheet steel.
6. Kinds and sizes of drills.
7. Type of flux and dipping solutions.
8. Thickness, specification, and commercial sizes of the following: galvanized iron, sheet copper, tin plate and terne-plate.
9. Thickness, specifications, and commercial sizes of the following: brass, monel, stainless steel, and zinc.
10. Sizes and shapes of soldering coppers.
11. Types of soldering pots—gas, gasoline, and charcoal.
12. Safety rules.
13. Sheet metal screws.
14. Usual commercial sizes for various kinds of stock.
15. Probable future for sheet metal industries.
16. The principle kinds of steel.
17. Standard sheet metal code.
18. Aviation techniques in working aluminum.

SUGGESTED PROJECTS

1. Tool box.
2. Tin cup.
3. Funnel.
4. Dust pan.
5. Measuring cup with flange lip or hooded.
6. Flower sprinkler.
7. Bucket.
8. Shovel.
9. Chicken watering trough.
10. Brooder.
11. Automatic feeder.
12. Waste basket.

C. Foundry and Heat-Treating

Specific Objectives

1. To stimulate the acquisition of knowledge relative to the design, structure, and materials used in pattern making.
2. To provide a general knowledge of foundry and heat-treating practices.
3. To provide a knowledge of ferrous and non-ferrous metals, alloying elements, melting temperatures, fluxes, etc.
4. To stimulate a study of the various processes used in the manufacture of iron and steel.

5. To develop skill in the uses of foundry and forge tools and equipment.
6. To develop an appreciation of the importance of good design and the appropriate use of metals.
7. To furnish a background for pupils desiring to enter the various related vocations.

FOUNDRY OPERATION UNITS

- | | |
|--|--|
| 1. Construct a simple pattern. | 27. Use auxiliary holding devices, such as crossbars, gagers, solders, nails, etc. |
| 2. Select proper shrinkage rule suitable for type of metal to be cast. | 28. Cut skim gate. |
| 3. Make a split pattern. | 29. Pour small castings using hand ladles. |
| 4. Build a pattern by the segment process. | 30. Light smelting furnace. |
| 5. Make core prints. | 31. Build proper equipment for handling molten metal. |
| 6. Prepare sand for molding. | 32. Skim molten metal. |
| 7. Cut sand. | 33. Handle molten metal. |
| 8. Test sand for proper moisture. | 34. Keep a steady stream of metal flowing into the mold. |
| 9. Riddle sand. | 35. Dispose of left-over metal. |
| 10. Select flask and arrange patterns. | 36. Pour light and heavy work. |
| 11. Ram a mold. | 37. Clamp mold. |
| 12. Use parting and facing materials. | 38. Identify molding, fire, and free sands. |
| 13. Vent mold. | 39. Clean and care for crucibles. |
| 14. Remove pattern. | 40. Alter flask and adjust pins. |
| 15. Use slick, spoon, etc. | 41. Build flasks and molding boards. |
| 16. Patch broken mold. | 42. Select gagers, solders, and nails for retaining sand. |
| 17. Cut sprue gate. | 43. Use shovel in handling sand and other materials. |
| 18. Cut an irregular parting in a mold. | 44. Use core plates in handling sand and other materials. |
| 19. Make a sand core. | 45. Place patterns on a molding board. |
| 20. Prepare and pour metal. | 46. Swab, rap, and draw patterns. |
| 21. Remove gates and clean castings. | 47. Use vent rods and risers in renting a mold. |
| 22. Set a core in a mold. | 48. Pre-heat crucibles. |
| 23. Judge the heat of metal by color. | 49. Select and set sprues. |
| 24. Make a pattern from a commercial job. | 50. Test for pouring temperature. |
| 25. Use bellows. | |
| 26. Draw pattern out of sand. | |

FOUNDRY INFORMATION UNITS

- | | |
|--|--|
| 1. Types of materials used in pattern making. | 12. Type of patterns. |
| 2. Classifications of castings as to strength, toughness, durability. | 13. Methods of finishing. |
| 3. Types of molding: Green-sand work, core work, dry-sand work, form work. | 14. Terminology used in foundry. |
| 4. How to select proper sand for class of work to be done. | 15. Types and kinds of facing materials. |
| 5. Types of flasks. | 16. Molding tools and equipment. |
| 6. Manufacture of iron and steel. | 17. Cores and binders. |
| 7. Source and use of copper. | 18. Safety measures and health precautions. |
| 8. Source and use of brass. | 19. Cupola and melting practices. |
| 9. Source and use of lead. | 20. Methods of cleaning castings |
| 10. Source and use of aluminum. | 21. Identification of metals. |
| 11. Type of metals and their melting points. | 22. Identification of molding, fire, and free sands. |
| | 23. Identification of clay and lining mixture. |

24. Fuels used to light core ovens and furnaces.
25. Chaplets and their use.
26. Where metals used in foundry are obtained and prepared for use.
27. Characteristics of metals used in foundry.
28. Melting points of metals.
29. Source of sand materials.
30. Compositions of sands.
31. The manufacture and mining of facing materials.
32. Purpose of blackenings and how accomplished.
33. Relation of foundries to other industries.
34. Opportunities in foundry work.

SUGGESTED PROJECTS

1. Book ends.
2. Door stops.
3. Door knockers.
4. Gear blanks.
5. Small anvil.
6. Andirons.
7. Name plate.
8. Candlestick and holders.
9. Paper weights.
10. Lamps.
11. Plaques.

FORGING AND HEAT-TREATING OPERATION UNITS

1. Build and maintain a forge fire.
2. Light and operate a gas forge.
3. Fit and hold work with tongs.
4. Heat work in force to working heat.
5. Measure and cut stock.
6. Draw out and upset stock.
7. Forge round and rectangular stock.
8. Bend eyes and scrolls.
9. Twist square or rectangular stock.
10. Punch hot metal.
11. Clean tuyere.
12. Make coke from green coal.
13. Decrease thickness, width, or both and increase length.
14. Point stock.
15. Flare stock.
16. Twist metal.
17. Cut off stock.
18. Use cold cutter.
19. Use hot cutter.
20. Use hardie cutter.
21. Grind and care for tools.
22. Use forge vise.
23. Use edge of anvil.
24. Use jigs.
25. Use scroll horn and wrench.
26. Prevent fractures.
27. Prepare stock for hardening.
28. Heat stock for hardening.
29. Anneal stock.
30. Use heated block for tempering.
31. Case harden.
32. Use fluxes.
33. Determine metals by spark test.
34. Lay out and measure given pattern.
35. Use square, calipers, center punch, scratch awl, and tram-mel points.
36. Use lever shear.
37. Estimate a bill of material.
38. Read blueprints.
39. Properly forge a cold chisel and punch.
40. Harden and temper a cold chisel and punch.
41. Test cold chisel and punch for toughness.
42. Heat-treat cold chisel or punch in gas forge or electric furnace.

FORGING AND HEAT-TREATING INFORMATION UNITS

1. Manufacture of steel and iron.
2. Identification and characteristics of the following metals: machinery steel, mild steel, tool steel, Swedish iron, and wrought iron.
3. Types and kinds of fuels.
4. Source and composition of common fuels.
5. Types of cooling mediums used in heat-treating.
6. Advantages and disadvantages of fuels, cooling mediums, etc.
7. Case hardening materials and cautions to observe.
8. Smoothing and polishing materials.
9. The relative location of shop equipment.
10. Types of forges and function of their various parts.
11. The anvil, the use of its various parts.
12. Names and uses of blacksmith tools.
13. Effect of heat on steel.

14. The principles of welding.
15. How fluxes act.
16. Annealing of ferrous and non-ferrous metals.
17. Type of fire used in forge.
18. Proper heat-treatment of metals.
19. Safety Precautions.
20. The proper handling of tools and materials.
21. Shop problems involving fundamentals of arithmetic, fractional measurements.
22. How to estimate a bill of material.
23. Correct pronunciation and spelling of tools, materials, operations and processes.
24. Testing of metals (heat-treating).
25. Heat-treatments of non-ferrous alloys.
26. Types of heat-treating furnaces and equipment.
27. Types of quenching equipment.
28. Types of liquid baths.
29. Effect of improper heating on metals.
30. Tempering colors and degrees of each.
31. Oxidizing fire.

SUGGESTED PROJECTS

1. Tire tool set.
2. Hammer heads.
3. Hooks.
4. Pinch bars.
5. Knives.
6. Cold chisel.
7. Pin punches and solid punches.
8. Scratch awls.
9. Center punch.

EXERCISE WORK

1. Draw and upset a round stock square.
2. Draw and upset square stock round.
3. Anneal samples of common steels and perform fracture test.
4. Harden samples of common steels and perform fracture test.
5. Temper samples of common steels and perform fracture test.
6. Case harden machine steel.

D. Welding—Arc and Oxy-acetylene

Specific Objectives

1. To provide a knowledge of elementary electricity which forms the basic principles of the arc welding machine.
2. To acquire a knowledge of the different types of welding equipment.
3. To establish definite habits of safety.
4. To develop skill in the use of welding and cutting tools.
5. To become familiar with various kinds of metal and the means of identifying them.
6. To become familiar with the methods employed in testing welds.

ARC WELDING OPERATION UNITS

1. Strike an arc and run flat beads.
2. Run continuous beads.
3. Weave and oscillate.
4. Build up a pad.
5. Use different size electrodes.
6. Construct Tee or fillet welds.
7. Make a butt weld with bare electrode.
8. Do vertical welding.
9. Cut using the electric arc.
10. Weld with bronze electrode (shielded arc).
11. Weld a butt pipe weld using shielded arc.
12. Set machine for proper polarity.
13. Test welds properly.
14. Weld light gauge steel.

ARC WELDING INFORMATION UNITS

1. Precautions and safety practices.
2. Standard welding symbols.
3. Types of joint construction and design.
4. Development of arc welding.
5. Types of welding machines.
6. Types of welding electrodes.
7. Knowledge of reverse and straight polarity.
8. Principles of the arc welder.
9. Methods of striking an arc.
10. Common methods used in welding various joint construction.
11. Expansion and contraction.
12. Cutting with electric arc.
13. The principles of arc weld surfacing.
14. Welding accessories essential.
15. Jig construction.
16. Identifying of different metals.
17. Effect of arc length, amps, and speed on bead.
18. Padding, building up plates.
19. Penetration.
20. Speed of welding.
21. Strength of welds.
22. Preparation of work.
23. Normalizing.
24. Preheating and annealing.
25. Qualities of efficient cables.
26. Types of electrode holders.
27. Care of materials to be welded before the arc is applied.
28. Knowledge of coated electrodes.
29. Materials used for electrodes.
30. Types of eye shields.

OXY-ACETYLENE WELDING OPERATION UNITS

1. Connect oxygen supply to the torch.
2. Connect acetylene supply to the torch.
3. Operate welding torch.
4. Adjust neutral, excess acetylene and excess oxygen flames.
5. Operate the cutting torch.
6. Apply general operating rules.
7. Melt various metals to learn their characteristics.
8. Prepare steel plate for single "vee" joint, double "vee", etc.
9. Test weld for penetration.
10. Weld typical joints on sheet metal.
11. Construct simple frame and weld.
12. Bronze weld cast iron.
13. Identify metals by spark test.
14. Handle welding outfit safely.
15. Care for and set up apparatus.
16. Run continuous beads on flat work using light gauge metal.
17. Recognize action of molten metal under flame.
18. Make butt welds in different gauge metals.
19. Bevel steel plate, cut holes in steel plate and cut off rivet heads.
20. Heat and bend metal into various angles.
21. Bronze-surface steel and cast iron parts.
22. Make a hose connection or a splice; using scrap piece of hose.
23. Cut cast iron.
24. Weld cast iron with cast rod.
25. Pre-heat cast iron for welding.
26. Care for expansion and contraction in welding.
27. Lap weld flat, vertical, and overhead.
28. Make a "tee" weld flat, vertical, and overhead.
29. Make a butt, "tee", angular and fillet weld (pipe welds).
30. Make a flange weld.
31. Make a butt weld open single "vee".
32. Make tubular butt weld.
33. Make a vertical fillet weld.
34. Make a combination plate and tube fillet weld.
35. Weld aluminum, cast and rolled.
36. Weld stainless steel.

OXY-ACETYLENE WELDING INFORMATION UNITS

1. Precautions and safety practices.
2. Standard welding symbols.
3. Types of joint construction and design.
4. Historical development of oxy-acetylene welding.
5. Construction and operations of torches.
6. Construction and operations of regulators.
7. Welding and cutting accessories.
8. Preparing for welding.

9. The oxy-acetylene flame.
10. Characteristic of oxygen and acetylene.
11. Principles of oxy-acetylene cutting.
12. Setting-up apparatus.
13. Scope of the oxy-acetylene process.
14. Welding of different metals.
15. Explosive gas mixtures—backfires and flashbacks.
16. Characteristics of iron and steel.
17. Welding of non-ferrous metals.

SUGGESTED PROJECTS

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|--------------------|-----------------------|
| 1. Stools. | 12. Trailer frames. |
| 2. Brackets. | 13. Toys. |
| 3. Garden tools. | 14. Hangers. |
| 4. Tool rests. | 15. Map stands. |
| 5. Grates. | 16. Lamps. |
| 6. Fireplace sets. | 17. Candle holders. |
| 7. Andirons. | 18. Stock rack. |
| 8. Music stands. | 19. Magazine rack. |
| 9. Tool cabinets. | 20. Radio table. |
| 10. Wrenches. | 21. Welding table. |
| 11. Door stops. | 22. Welding rod rack. |

Chapter IX

ELECTRICAL WORK

The field of electricity is so broad that only a small part of it can be included in the industrial arts curriculum. There are, however, certain basic fundamentals and practical phases of the field that can well be presented with value to students in junior and senior high school. It is not considered desirable, in most instances, to go beyond the basic fundamentals as this would approach specialized vocational training.

Generally, industrial arts work should not be organized with a view of preparing students for specific electrical employment. Rather, available time should be spent in giving them a broad understanding of electrical theory through the use of carefully selected projects.

Elementary electrical work contains very few "doing" units that require any considerable degree of manipulative skill. Most of the operations are readily learned, such as the splicing of wires, removing insulation, soldering, connecting to binding-posts, insulating, and the like, together with certain standard methods of construction. The "knowing" units concern the flow and transmission of current, the characteristics of current, and the methods employed in making it serve our purposes in common ways.

Pupils can do many interesting things with the electric current, but the projects assigned or approved should be the means of teaching fundamental principles. The installation of a bell circuit introduces certain manipulative skills and certain problems of construction, but these are largely superficial. Such a task affords a safe, easy, and inexpensive means of presenting ideas about the electric circuit, the use of metallic conductors, and the principles of electromagnetism.

Specific Objectives

1. To provide the student with a knowledge of elementary electrical theory.
2. Provide the student an opportunity to develop skill in use of tools for electrical work.
3. Provide the student with a knowledge of materials used in electrical work.
4. Train the student to be an intelligent consumer of electricity and electrical devices in the home and community.
5. Provide the student with a conception of world significance concerning the field of electricity.

OPERATION UNITS

1. Read a wiring-diagram.
2. Make a wiring-diagram.
3. Plan a procedure for doing a job.
4. Remove insulation or covering from wire.
5. Make a rat-tail splice.
6. Make a Western Union splice.
7. Make a tap splice.
8. Solder and tape a splice.
9. Attach wire to a binding-post.
10. Uncoil wire without twisting.
11. Connect dry-cells in series.
12. Connect dry-cells in parallel.
13. Plan and construct a simple electric circuit which may be opened and closed at one point.
14. Plan and construct an electrical circuit which may be opened and closed at either or both of two points.
15. Plan and install electric devices in a circuit in series.
16. Plan and install electric devices in a circuit in parallel.
17. Plan and construct circuits to give selective control of devices in the circuit.
18. Attach a cord to a lamp-socket.
19. Attach a cord to a plug.
20. Test and replace fuses.
21. Read an electric meter.
22. Interpret the identity marks on a motor.
23. Administer first aid in case of shock.
24. Attach a terminal to a wire.
25. Provide a "make and break" in a circuit, as in a timer.
26. Apply the principle of electromagnetic force in order to operate mechanisms, as in a buzzer or bell.
27. Employ resistance to generate heat, as in a toaster or a soldering-copper.
28. Wire a circuit so as to prevent a dangerous rise in temperature, due to resistance.
29. Reduce voltage on a line.
30. Locate a break in a circuit.
31. Tie an underwriter's knot.
32. Calculate the resistance of a circuit, using Ohm's Law.
33. Install a snap-switch.
34. Install a flush-switch.
35. Install a flush-receptacle.
36. Measure voltage with a volt-meter.
37. Measure amperage with an ammeter.

INFORMATION UNITS

1. The properties of the magnet and the characteristics of the magnetic field.
2. The source of electric current or pressure.
3. The characteristics of the electric current.
4. How the electric is conveyed.
5. The kinds of conductors and their uses.
6. The meaning of volt.
7. The meaning of ampere.
8. The meaning of watt.
9. How the electric current gives power.
10. How the electric current gives light.
11. How the electric current gives heat.
12. The difference between direct and alternating current.
13. The sources of direct current.
14. The source of alternating current.
15. The meaning of phase and cycle.
16. The meaning of "series" and "parallel", and the difference between the effects of these connections.
17. Resistance and its effect.
18. Ohm's Law.
19. How the electric bell works.
20. Why splices should be soldered.
21. The importance of proper insulation.
22. The sizes of wire.
23. The effect of an overload.
24. Symbols used in wiring-diagrams.
25. Safety rules in working with electricity or electrical appliances.
26. How the rheostat works.
27. How the volt-meter works.
28. How the ammeter works.
29. How the electric meter works.
30. The construction of the dry-cell and how it works.
31. The construction of the wet-cell and how it works.
32. The kinds of fuses and their uses.
33. The kinds of electric lamps and how they are made.

34. The causes and effects of short circuits.
35. The types of motors and how to identify them.
36. The types of transformers and how they work.
37. The types, purposes, and working of condensers.
38. The principle of the three-wire system.
39. Pay-roll jobs and opportunities in the electrical industry.
40. Imperfections in housewiring which involve fire hazards or personal injury.
41. Modern electric light fixtures.

SUGGESTED ELECTRICAL JOBS

1. Make a wiring-diagram and install a simple bell circuit.
2. Make a wiring-diagram and install a bell circuit, using one button and two bells in parallel.
3. Make a wiring-diagram and install one bell, to operate from two push-buttons.
4. Make a wiring-diagram and install a call system, one button to operate a bell and another a buzzer.
5. Make a wiring-diagram and install a return-call system.
6. Make a wiring-diagram and install a light, to operate from either or both of two switches.
7. Plan and construct an electromagnet.
8. Plan and construct a transformer.
9. Install a transformer in a 110-volt line.
10. Plan and construct a simple buzzer.
11. Plan and construct an induction coil.
12. Plan and construct a simple motor.
13. Plan and construct a heater.
14. Construct an extension-cord for a lamp.
15. Construct an extension-cord for a heater.
16. Install a feed-through switch in an extension-cord.
17. Plan and construct a simple lighting circuit, lamps in parallel, using a flush-switch.
18. Plan and construct a lighting circuit, lamps in series, using a snap-switch.
19. Wire an electric lamp.
20. Construct a simple telegraph system.

Chapter X

AUTOMOTIVE SHOP

Most of our youth will eventually own and operate automobiles, yet few of the school systems provide any training in auto-mechanics. The automobile is more widely used than any other major machine. It is important, therefore, that people know something of the principles upon which it operates in order that it may be used with a greater degree of satisfaction and safety. The owner should know something about the causes of the common failures and how to prevent them. If we are to teach people to operate and care for automobiles intelligently, the instruction must be specific and systematic and the shop equipment must be sufficient and up to date.

The list of operation units outlined is not necessarily a list of repairs each student should be able to make, but a list of experiences he should have in order that he may understand some of the fundamental principles of machines, how to care for machines, and how to make minor repairs and adjustments.

Specific Objectives

1. To give the student a fundamental understanding of power development.
2. To indicate the relationship between the theoretical and the practical aspects of gasoline engines.
3. Provide the student an opportunity to develop basic skills in use of automotive equipment.
4. Provide the student an opportunity to develop an intelligent understanding and habits of safety in the use and operation of automobiles.

OPERATION UNITS

1. Plan the procedure in doing a job.
2. Test and clean spark-plugs.
3. Clean and adjust breaker-points.
4. Grease a car.
5. Change oil in the engine.
6. Wash and polish a car.
7. Repack water-pump glands.
8. Clean gasoline lines.
9. Replace light bulbs.
10. Remove sediment from the radiator.
11. Test and care for the battery.
12. Adjust tension on a fan or generator belt.
13. Remove and replace a tire.
14. Repair punctures with cold patches.
15. Repair punctures with hot patches.
16. Insert a boot in a casing.
17. Grind valves.
18. Trace lines of power from engine to wheel.
19. Adjust the charging rate of a generator.
20. Clean the commutator.
21. Iron out dents or bends in fenders or body.
22. Retouch scratches or damage to the finish.

23. Replace a water-manifold gasket on a water-cooled engine.
24. Align the front wheel.
25. Adjust mechanical brakes.
26. Reface valves and valve seats.
27. Trace lines of power from battery to engine for starting.
28. Trace lines of power from engine to generator.
29. Trace lines of power from engine to distributor.
30. Trace electric circuit from generator to battery.
31. Inspect a vacuum-tank.
32. Inspect a fuel-pump.
33. Trace and test the lighting system.
34. Test, focus, and adjust lights.
35. Adjust valve clearance in L-head engines.
36. Adjust valve clearance in valve-in-head engines.
37. Inspect and adjust front-wheel bearing.
38. Test for and correct lost motion in the steering mechanism.
39. Inspect and adjust a clutch.
40. Remove and inspect a floating rear axle.
41. Remove and inspect a semi-floating axle.
42. Inspect and adjust the differential.
43. Adjust hydraulic brakes.
44. Adjust main bearings.
45. Adjust connecting-rod bearings.
46. Scrape a bearing.
47. Time valves.
48. Clean and adjust the carburetor.
49. Trace and test the ignition system.
50. Locate and repair a short circuit in the electrical system.
51. Locate and repair an open circuit in the electrical system.
52. Test an ignition-coil.

INFORMATION UNITS

1. The types and uses of anti-friction bearings.
2. What is meant by camber, caster, and toe-in, and how they affect the operation of the car.
3. The principle of the worm-gear, and how it is applied to the steering-gear.
4. How the cam-and-lever type of steering-gear works.
5. How the planetary type of steering-gear works.
6. The different types of axles.
7. The different types of brakes, and the principal characteristics of each.
8. The types of engine bearings, and the reasons for using such bearings.
9. The kinds of pistons and types of rings, their purposes and characteristics.
10. How the fuel-pump works.
11. The purpose of the carburetor, and how it works.
12. The necessity for proper lubrication and how it is accomplished.
13. Safety precautions while driving.
14. The types of clutches, and how they work.
15. The universal joint, and how it works.
16. How the gear-shift transmission works.
17. How the planetary transmission works.
18. How the free-wheeling device works.
19. How the differential works.
20. The meaning of gear ratio, and its effects on power and speed.
21. How fluid drive works.
22. How the starting-system works.
23. How the lighting-system works.
24. How the ignition-system works.
25. How the over-drive mechanism works.
26. The meaning of cycle in a gas engine.
27. How the gas-pump works.

Chapter XI

PRINTING

Printing is, and for centuries has been, one of the leading industries of the world. Millions of men and women are employed in the printing industry. Our entire educational system depends upon the printed page. Our general public is affected by it through newspapers, magazines, etc. It is therefore logical to expect that more emphasis will be placed on this phase of our education in the future than has been in the past.

The program presented here is on the Junior and Senior High School level. The program has been presented in such a way that the instructor may select and use those units which fit his particular course.

Specific Objectives

1. To develop a knowledge of the method of procedure of producing printing.
2. To develop the ability to definitely plan an orderly procedure for executing a job.
3. To develop an appreciation of the printed page.
4. To develop habits of good workmanship through the medium of printing.
5. To acquire industrial information as a means of educational and vocational guidance.

OPERATION UNITS

1. Locate instantly any letter or character in the case.
2. Set the composing stick to measure.
3. Hold a stick properly.
4. Set type—straight matter.
5. Read type in a composing stick.
6. Dump a stick.
7. Tie up a form.
8. Take a proof on a proof-press.
9. Take a hammered proof.
10. Read proofreader's marks.
11. Make corrections.
12. Wash type and rules.
13. Distinguish difficult letters such as n, u, b, d, etc.
14. Distribute type.
15. Distribute leads, slugs, and brass rules.
16. Remove a job from galley to imposing table.
17. Remove a job from imposing table to galley.
18. Plan a job.
19. Collect all necessary material for the job.
20. Set various styles of paragraphs.
21. Work and turn.
22. How to lay a case.
23. Clean a case.
24. Lubricate a job press.
25. Ink a job press.
26. Prepare a tympan.
27. Set gauge pins.
28. Make ready.
29. Feed a job press.
30. Prevent offset.
31. Wash up a job press.
32. Care for an ink slab.

33. Count paper.
34. Jog stock.
35. Pad paper stock.
36. Hand folding.
37. Wrap a package neatly.
38. Lock up form for press.
39. Setting a tabular form using leaders.
40. Setting a tabular form using rule.
41. Make up a six-page folder.
42. Use of initial letters.
43. Set a display job; newspaper advertisement, placard, or hand bill.
44. Set form for two-color job.
45. Lock up forms for two-color job.
46. Mixing printing inks.
47. Punch and perforate stock.

INFORMATION UNITS

1. The layout of the California Job Case.
2. The names of the principal tools, materials, machines and equipment.
3. The component parts of a platen press.
4. The printer's system of measurement.
5. Sizes of type and spacing material.
6. The component parts of a type.
7. Rules for punctuation, spelling, capitalization, and division of words.
8. The parts of a composing stick.
9. Posture, health, and safety habits.
10. Printer's terms and meanings.
11. Brief history of printing.
12. How paper is made.
13. How ink is made.
14. Related mathematics.
15. Trade practices.
16. The use of layouts.
17. The use of borders.
18. Principles of color harmony.
19. Principles of tone harmony.
20. Principles of shape harmony.
21. The principle of balance.
22. The principle of proportion.
23. The principal kinds of paper used in printing and the type of work for which each is generally used.
24. Standard sizes and weights of paper stock.
25. Methods of designating quantities, sizes and qualities of paper.
26. Composition and care of press rollers.
27. Kinds of ink and methods of handling.
28. How cuts are made: zinc etchings, half tones, electrotypes, wood, linoleum, and rubber.
29. How a half tone cut is "made ready."
30. How wire stitching is done.
31. Opportunities and requirements of the printing trades.
32. Differentiation between folders and booklets; posters, and placards.
33. Care of equipment.
34. Importance of cleanliness in handling paper.
35. The composition and care of type.
36. The meaning of a font.

SUGGESTED ASSIGNMENTS

1. Set composing stick to a given measure and set a line of type composed of words involving the use of the same letters; the, they, them, then, these, those, etc.
2. Set a short paragraph composed of definite instructions about some phase of type setting.
3. Set corner card for envelope.
4. Set a calling card.
5. Set a business card.
6. Set a personal or professional note head.
7. Set a business letterhead.
8. Set a statement.
9. Set an invoice.
10. Set a bank check.
11. Lay out and set an announcement—professional or business.
12. Set a menu for a luncheon or dinner.
13. Plan and set a one-page program for school assembly.

14. Plan and set a ticket for school play or game.
15. Design and set a title page for booklet.
16. Design layout and set a placard announcing school play.
A. For one color.
B. For two colors.
17. Set a rule form with two or more columns to run "work and turn."
18. Set a panel using initial letter (a motto or poem).
19. Set a four-page program for a music recital.
20. Lay out and set a newspaper advertisement with a rule border.
21. Set a tabular form with leaders as cross members and brass column rules.
22. Prepare stock for jobs to be printed—count and cut.
23. Lock forms for press.
24. Prepare press for job—clean, oil, and ink.
25. Make job ready for running: prepare tympan; adjust grippers; pull proof; set gauge pins; underlay and overlay where necessary; manipulate ink if needed; check carefully for proper volume of ink to be carried. Run job. Distribute printed sheets on drying racks.
26. Inspect printed forms; jog; wrap; label; and deliver.
27. Make scratch pads from scrap paper: perforate, pad, stitch (wire staple), bind top with gummed paper tape, trim.
28. Print, fold, saddle stitch, trim, and wrap for delivery booklet of four or more pages.

The field of printing furnishes an inexhaustible avenue for activities which are related to every phase of the school program: spelling lists; mathematical problems; art projects such as wood cuts and linoleum blocks; cut out tags and programs; ballots and campaign material for student council elections; lunch room signs and price tags; the school paper; office forms, etc.

Chapter XII

GENERAL SHOP, HANDCRAFTS AND HOME MECHANICS

- | | |
|-------------------------|-----------------------------|
| 1. General Shop | III. General Metal Work |
| I. General Drawing | Forge and Wrought-Iron-work |
| Orthographic Projection | Oxy-acetylene and Arc |
| House Planning | Welding |
| Design | Sheet Metal |
| II. General Woodworking | Machine Shop |
| Hand Woodworking | 2. Handcrafts |
| Woodturning | I. Leathercraft |
| Machine Woodworking | II. Wood Carving |
| Wood Finishing and | III. Plastics |
| Upholstering | IV. Art Metal |
| | 3. Home Mechanics |

General Drawing

OPERATION UNITS

- | | |
|---|--|
| 1. Sharpen a drawing pencil. | 20. Transfer measurements with dividers. |
| 2. Plan a drawing and make layout. | 21. Divide a line into equal parts. |
| 3. Make a free-hand working sketch. | 22. Draw an octagon. |
| 4. Draw vertical lines and T-square sketches and triangles. | 23. Draw a hexagon. |
| 5. Draw horizontal lines. | 24. Transfer or enlarge by squares. |
| 6. Use correct lines and symbols in drawing. | 25. Make a simple topographical drawing. |
| 7. Block out views. | 26. Plan a landscape. |
| 8. Make front and top views. | 27. Bisect an angle. |
| 9. Make three views. | 28. Bisect an arc. |
| 10. Dimension a drawing. | 29. Draw an ellipse. |
| 11. Draw views with hidden edges. | 30. Develop a pyramid-shaped object. |
| 12. Use the pencil compass. | 31. Develop a cone-shaped object. |
| 13. Make arrow heads. | 32. Make a machine drawing. |
| 14. Make numerals. | 33. Make a detailed drawing. |
| 15. Make upper case letters. | 34. Make an electric wiring diagram. |
| 16. Make lower case letters. | 35. Make a pictorial sketch. |
| 17. Draw to scale. | 36. Make a blue print. |
| 18. Draw sectional views. | 37. Draw a simple floor plan. |
| 19. Make an auxiliary view. | 38. Draw elevations. |

GENERAL DRAWING INFORMATION UNITS

- | | |
|-------------------------------------|---|
| 1. Drawing pencils. | sign (structure, contour, surface enrichment). |
| 2. Conventional breaks in material. | 8. Architectural symbols. |
| 3. Lettering. | 9. Elements of a building. |
| 4. Drawing in industry. | 10. Building materials (brick, tile, block, wood-siding materials, roofing, insulation, and interior trim). |
| 5. The alphabet of lines. | 11. Elements of design. |
| 6. Common drawing symbols. | |
| 7. Elementary principles of de- | |

GENERAL WOODWORK OPERATION UNITS

1. Measure with a rule.
2. Gauge with a pencil or marking gauge.
3. Use a try-square.
4. Sharpen edge tools.
5. Adjust a plane.
6. Plane a surface true.
7. Plane edge true with adjoining surface.
8. Square end grain.
9. Proceed properly in squaring stock.
10. Use a cross cut or rip saw.
11. Use a back saw.
12. Use a coping saw.
13. Use a spokeshave.
14. Finish curves with rasp or file.
15. Bore holes with auger bit.
16. Countersink holes.
17. Fasten with screws.
18. Use a chisel.
19. Drive and draw nails.
20. Set T-bevel.
21. Cut a chamfer.
22. Use hand screws and bar clamps.
23. Use a block plane.
24. Use a compass saw.
25. Sharpen and use a scraper.
26. Make a half-lap joint.
27. Cut a dado.
28. Make a cross-lap joint.
29. Make a mitre joint.
30. Make a blind mortise and tenon joint.
31. Make an edge to edge joint.
32. Fit hinges.
33. Construct a panel.
34. Inlay a wood surface.
35. Make and fit a drawer.
36. Sharpen auger bits.
37. Prepare and apply stain.
38. Prepare and apply fillers.
39. Prepare and apply shellac.
40. Apply varnish.
41. Apply lacquer.
42. Apply enamel.
43. Apply a satin finish.
44. Apply wax.
45. Upholster a padded seat.
46. Upholster with webbing and rolled edges.
47. Clean brushes.
48. Make a bill of material.
49. Plan procedure in doing a job.
50. Smooth a surface with sandpaper.
51. Match straight grained veneers.

MACHINE WOODWORKING OPERATION UNITS

The Jointer

1. Adjust the jointer.
2. Joint an edge.
3. Cut a chamfer or bevel.
4. Remove wind from stock.
5. Cut a rabbet.
6. Cut tapers.
7. Safety rules on the jointer.

The Bandsaw

1. Adjust the bandsaw.
2. Saw curves.
3. Safety rules on the bandsaw.

The Table Saw

1. Set and adjust the table saw.
2. Rip and cut off stock.
3. Cut grooves and dadoes.
4. Cut tenons.
5. Cut mitres.
6. Cut tapers.
7. Safety rules on the table saw.

The Surfacer

1. Adjust the surfacer.
2. Surface stock on the surfacer.
3. Safety rules on the surfacer.

The Shaper

1. Flute and reed stock.
2. Shape straight edges.
3. Shape curved edges.
4. Use pattern or jig in duplicating.
5. Safety rules on the shaper.

The Mortiser

1. Set up and adjust.
2. Cut mortises.
3. Safety rules on the mortiser.

The Lathe

1. Mount work between centers.
2. Rough down with gouge.
3. Smooth with a skew.
4. Lay off pattern on stock.
5. Mark with a skew.
6. Cut shoulders with a skew.
7. Use a parting tool.
8. Cut tapers with a skew.
9. Cut beads with a gouge.
10. Cut beads or convex surfaces with a skew.
11. Scrape with a diamond point.
12. Cut coves with a gouge.

13. Mount work on a face-plate.
14. Mount work on screwchuck.
15. Size work on face-plate.
16. Fasten for split turning.
17. Cut off stock in the lathe.

18. Make a dowel joint.
19. Sandpaper stock in lathe.
20. Apply finish in lathe.
21. Safety rules on the lathe.

GENERAL WOODWORK INFORMATION UNITS

- | | |
|--|---------------------------------|
| 1. The common woods. | 19. Varnish. |
| 2. Cutting and milling lumber. | 20. Shellac. |
| 3. The seasoning of lumber. | 21. Lacquer. |
| 4. Standard grades and dimensions of lumber. | 22. Paints and enamels. |
| 5. Plywood and veneer. | 23. Fillers. |
| 6. Laying out tools. | 24. Nails and brads. |
| 7. Planes. | 25. Wood screws. |
| 8. Hammers and mallets. | 26. The parts of a plane. |
| 9. Clamps and holding devices. | 27. The table saw. |
| 10. Boring and drilling tools. | 28. The jointer. |
| 11. Wood scrapers. | 29. The surfacer. |
| 12. Coated woodworking abrasives. | 30. The bandsaw. |
| 13. Grinding and sharpening stones. | 31. The shaper. |
| 14. Chisels and gouges. | 32. The mortiser. |
| 15. Woodworking joints. | 33. The lathe. |
| 16. Hardware. | 34. The jig saw. |
| 17. The kinds of glue. | 35. The types of circular saws. |
| 18. The kinds of stains and their uses. | 36. The sheen coat finish. |
| | 37. Saws. |
| | 38. Machine cuts. |

SUGGESTED PROJECTS

Elementary Woodworking

1. Trellis.
2. What-nots or wall shelves.
3. Bookends and racks.
4. Broom holder.
5. Cup and saucer rack.
6. Fiddle back footstool.
7. Magazine or book stand.
8. End table of simple construction.
9. Game boards.
10. Lawn ornaments.
11. Door stops.
12. Letter holders.
13. Table lamps such as Town Pump design.
14. Serving tray.
15. Glove box.
16. Clock frames.

Wood Turning

1. Darning ball.
2. Gavels.
3. Mallets.
4. Candle sticks and sconces.
5. Table and floor lamps.
6. Wall lamps.

7. Various tables with turned legs and stretchers.
8. Four poster beds.
9. Foot stools.
10. Chairs.
11. Pedestals.

Advanced Woodworking

1. End tables.
2. Coffee tables.
3. Sewing tables.
4. Card tables.
5. Bedsteads.
6. Book cases.
7. Cedar chests.
8. Foot stools.
9. Medicine cabinets.
10. Clock frames.
11. Chests of drawers.
12. Night stands.
13. Lawn furniture.
14. Tool boxes.
15. Boats.
16. Archery sets.
17. Magazine racks.
18. Mirror and picture frames.
19. Chairs.
20. Desks.

GENERAL METAL WORK OPERATION UNITS

1. Make out a bill of material.
2. Plan shop jobs.
3. Measure and lay out with a scale.
4. Transfer patterns to sheet metal.
5. Use tinner's snips.
6. Tin a soldering copper.
7. Solder tin, copper, and galvanized iron.
8. Light and operate torch or furnace.
9. Prepare cut acid flux.
10. Use the bar folder.
11. Use the squaring shears.
12. Punch and drill holes in sheet metal.
13. Rivet sheet metal.
14. Groove with hand groover.
15. Form sheet metal by hand.
16. Roll sheet metal on forming rolls.
17. Turn edge for a hem.
18. Fold a curved edge.
19. Wire an edge.
20. Use the combination machine for wiring, turning, and burring.
21. Anneal non-ferrous metals.
22. Pierce with jeweler's saw.
23. Tool soft metal foil.
24. Chase a design on metal.
25. Form objects by raising.
26. Clean non-ferrous metals.
27. Planish surface of metal.
28. Flute raised objects.
29. Etch design in metal.
30. Buff and polish metal.
31. Coloring copper and brass.
32. Make simple chucks for metal spinning.
33. Make sectional chucks for spinning.
34. Spin a one-piece object.
35. Spin over sectional chuck.
36. Spin over bread-down chuck.
37. Cut threads with taps and dies.
38. Form scrolls with cold metal.
39. Twist square stock.
40. Peen metal surfaces.
41. Use the hack saw.
42. Build a forge fire.
44. Forge tapers and flares.
45. Forge rings, eyes, and irregular shapes.
46. Draw out tool steel.
47. Anneal tool steel.
48. Harden and temper small tools.
49. Use center punch and cold chisel.
50. Case harden cold rolled steel.
51. Draw file and polish metal surfaces.
52. Use the drill press.
53. Use drill vise and V-block in drilling.
54. Mount chuck and face-plate on lathe.
55. Use the machinist's square.
56. Grind tool bits.
57. Start, stop, and reverse lathe.
58. Prepare stock for turning.
59. Do straight turning.
60. Do precision turning, using micrometers.
61. Use outside, inside, and hermaphrodite calipers.
62. Face and shoulder on the lathe.
63. Mount work in chuck.
64. Drill stock in the lathe.
65. Tap stock in the lathe.
66. Cut inside threads on lathe.
67. Taper in lathe.
68. Knurl stock in the lathe.
69. Use boring tool.
70. Use the cut-off tool.
71. Clean a file.
72. File and polish in lathe.
73. Clean, oil and care for shaper.
74. Regulate length of stroke.
75. Grind and set tool bit.
76. Mount work in shaper vise.
77. Clamp work on table.
78. Do straight surfacing.
79. Cut shoulders.
80. Cut ways and dovetails.
81. Set up the oxy-acetylene outfit and regulate pressure.
82. Weld straight joints in mild steel, copper, and cast iron.
83. Make a horizontal weld.
84. Make a fillet weld.
85. Bronze weld common metals.
86. Grind and bevel stock for welding.
87. Set up arc welding equipment.
88. Strike an arc and hold it on horizontal bead.
89. Make a butt weld.
90. Weld a fillet.
91. Make a simple one-piece pattern.
92. Make a split pattern.
93. Prepare foundry.
94. Riddle, sand, and ram a mold.
95. Pull a pattern.
96. Vent a sand mold.

97. Cut gates and risers in sand mold.
98. Pour molten metal.

99. Patch a torn or broken mold.
100. Light and operate smelting furnace.

GENERAL METAL WORK INFORMATION UNITS

1. Carbon tool steel.
2. Identification of iron and steel by their sparks.
3. Screws and bolts.
4. Twist drills.
5. Cutting compounds.
6. The machine lathe.
7. The shaper.
8. Chucks and face-plates.
9. Types of threads.
10. Standard tapers.
11. Attachments for the lathe.
12. Oxy-acetylene welding outfit.
13. Arc welding machine.
14. Casting metals.
15. Sheet metal tools.
16. Names, characteristics, and uses of the common metals.
17. How sheet metal is manufactured and sold.
18. The kinds of solder.
19. Soldering fluxes.
20. Sheet metal working machines.
21. Sheet metal seams.
22. Rivets.
23. Aluminum.
24. Brass.
25. Copper.
26. Hard solder.
27. Art metal hammers.
28. Drill, tap, and die tables.
29. The refining and processing.
30. Wrought iron and mild steel.
31. Safety rules for the engine lathe.
32. Safety rules for the shaper.
33. Safety rules for the forge.
34. Safety rules in heat treating.
35. Safety rules in arc welding.
36. Safety rules in oxy-acetylene welding.
37. Safety rules for the foundry.
38. Safety rules for metal spinning.
39. Safety rules for the general metal shop.

Forge and Wrought Iron Work

1. Punches.
2. Cold chisels.
3. Wrecking bars.
4. Knives.

5. Hay hooks.
6. Hasps.
7. Riveting hammer.
8. Scriber.
9. Soldering copper.
10. Screw driver.
11. Andirons.
12. Fireplace set.
13. Candlesticks.
14. Table lamps.
15. Floor lamps.
16. Tables and wrought iron legs.
17. Brackets.
18. Flower pot hangers.

Sheet Metal

1. Letter holders.
2. Book ends.
3. Letter openers.
4. Match box.
5. Sugar scoop.
6. Cookie cutter.
7. Dustpan.
8. Megaphone.
9. Funnel.
10. Napkin rings.
11. Garden trowel.
12. Candle sconce.
13. Lamp shades.
14. Fishing tackle box.
15. Tool box.
16. Waste basket.

Machine Shop

1. Scriber.
2. Punches.
3. Ballpeen hammers.
4. Setting-down hammers.
5. Bell centering punch.
6. Paperweights.
7. Screwdriver.
8. Lamps.
9. Candlesticks.
10. Saw mandrels.
11. Pulleys.
12. Plumb bob.
13. Machinist's clamps.
14. U-bolts.
15. Solder scrapers.
16. Hammer heads.
17. Hinges.
18. End wrenches.
19. V-blocks.
20. V-blocks clamps.

mold.
melting

Leather Work

OPERATION UNITS

1. Plan a procedure.
2. Measure a rule.
3. Create original designs.
4. Transfer designs.
5. Make duplicate parts.
6. Layout for a template.
7. Cut out a template.
8. Cut leather.
9. Lay out templates on leather.
10. Mark leather for cutting.
11. Prepare leather for tooling and stamping.
12. Tool outlines with tracer modeler.
13. Tool for flat modeling.
14. Emboss designs.
15. Stamp designs with stamping tools.
16. Stipple parts of designs.
17. Dye edges and surfaces.
18. Raise designs.
19. Crease edges.
20. Skive edges.
21. Splice lacing for stitching.
22. Punch for lacing.
23. Fasten key plates.
24. Do whip-stitch edge lacing.
25. Do button-hole stitch edge lacing.
26. Sew leather by hand and by machine.
27. Rivet with eyelets.
28. Rivet with split rivets.
29. Set snap buttons and bag plates.
30. Pad leather.
31. Insert gussets.
32. Assemble snap buttons.
33. Cement edges and lining.
34. Clean leather.
35. Polish leather.
36. Assemble notebook metal rings.
37. Bevel edges.
38. Bend metal for forms.
39. Assemble leather around forms.
40. Carve leather designs.
41. Plait simple belt.
42. Terminate thong work with crown and turk's head.
43. Fasten buckles with three holes fastening.
44. Attach a zipper.
45. Make waxed thread.

LEATHER WORK OPERATION UNITS

1. The history and early uses of leather.
2. Industrial unions and guilds.
3. The preparation of leather for tanning.
4. The tanning of leather.
5. The geographical sources of raw materials.
6. How to differentiate skins and hides.
7. The kinds of leather.
8. The by-products of leather.
9. How leather is sold.
10. The preparation and the uses of templates.
11. The essential leather tools and equipment.
12. The proper care of tools.
13. How to read working drawings.
14. The care of leather products.
15. The types of dyes and stains for leather decoration.
16. Consumer knowledge of leather and leather articles.
17. Occupational opportunities in the leather industries.

WOOD CARVING OPERATION UNITS

1. Transfer design to wood.
2. Do incised carving.
3. Carve in low relief.
4. Do simple high relief carving.
5. Duplicate carving.
6. Chip carving.

WOOD CARVING INFORMATION UNITS

1. Types of carving.
2. Carving tools.
3. Carving design.
4. The duplicate carver.

PLASTICS OPERATION UNITS

1. Read a drawing.
2. Make a bill of material.
3. Make a plan of procedure.
4. Measure with a rule.
5. Layout stock.
6. Hold stock in clamps.
7. Polish a surface.
8. Saw an edge.
9. File a plane surface.
10. Sand a plane surface.
11. Locate holes.
12. Centerpunch holes.
13. Drill holes.
14. Square stock.
15. Gage a line.
16. Fasten with cement.
17. Sand a round surface.
18. Layout a duplicate part.
19. Apply monogram filler.
20. Slit a surface.
21. Carve a surface design.
22. Transfer a design.
23. Laminate.
24. File an irregular surface.
25. Make a chamfer.
26. Attach fittings.
27. Countersink.
28. Bend to shape.
29. Fasten with machine screws.
30. Make an inlay.
31. Tap by hand.
32. Layout with a template.
33. Attach stock to a face-plate.
34. File stock in a lathe.
35. Sand stock in a lathe.
36. Ash stock in a lathe.
37. Buff stock in a lathe.
38. Polish stock in a lathe.
39. Measure with calipers.
40. Counterdrill by hand.
41. Turn a groove.
42. Counterbore in a lathe.
43. Turn a taper by the compound method.
44. Turn a bead.
45. Face an end.
46. Tap in a lathe.
47. Center stock in a chuck.
48. Mount a chuck.
49. Straight turn.
50. Drill stock in a chuck.
51. Round an end.
52. Turn to a shoulder.
53. Locate center holes.
54. Drill center holes.
55. Mount stock in lathe.
56. Center lathe.
57. Make a shrink fit.
58. Turn a taper by the set-over method.
59. Make a miter joint.
60. Make a bevel.
61. Make a butt joint.
62. Bore.
63. Cut threads on a lathe.
64. Thread a rod.
65. Apply lacquer.
66. Mount stock on a mandrel.
67. Dress a drill.
68. Sharpen an edged tool.
69. Grind a tool bit.
70. Dye cement.

PLASTICS INFORMATION UNITS

1. The types of plastics.
2. The constituents and properties of plastics.
3. The costs of plastics.
4. Drill speeds and feeds.
5. Lathe speeds and feeds.
6. Tap and drill sizes.
7. Taper tables.
8. Types of files.
9. Types of saw blades.
10. Carving tools.
11. Forms of lathe tools.
12. Cutting angles of lathe tools.
13. Cutting angles of drills.
14. Effects of water on plastics.
15. Heat resisting properties of plastics.
16. Bending heats.
17. Metal fittings.
18. Types of screw threads and screws.
19. Cements and cement dyes.
20. Coloring and finishing.
21. Abrasive materials.
22. Elements of part design.
23. Testing for hardness.
24. The history of plastics.
25. The uses of plastics in industry.
26. Opportunities in the plastic industries.

ART METAL WORK OPERATION UNITS

1. Plan a procedure.
2. Measure with a rule.
3. Buff with compound.
4. Shear metal with snips.
5. Make a pattern.
6. Finish metal with heat.

7. Finish metal with chemicals.
8. Finish metal with wax.
9. Smooth with hand buffer.
10. Transfer a pattern or design.
11. Saw with a jeweler's saw.
12. Apply lacquer.
13. Anneal metal.
14. Clean metal.
15. Planish metal.
16. Smooth metal on stake.
17. Drill a hole.
18. Planish an edge.
19. Pierce with a jeweler's saw.
20. File with a needle file.
21. Solder with a gas torch.
22. Shape metal over a stake.
23. Scribe a circle.
24. Raise metal on a wooden block.

25. Square metal.
26. Make a template.
27. Transfer a template.
28. Make a straight bend.
29. Fit a joint for soldering.
30. Chase a design.
31. Sweat with solder.
32. Decorate with repousse.
33. Overlay metal.
34. File bevel edge.
35. Solder with alcohol torch.
36. Shape on sandbag.
37. Flute on fluting stake.
38. Form over wooden form.
39. Solder aluminum.
40. Etch line on copper.
41. Set a stone.
42. Burnish an edge.
43. Set a rivet.

ART METAL WORK INFORMATION UNITS

1. Be able to read a working drawing.
2. Know and practice safe work methods.
3. The composition of metals used.
4. The use of gages for thickness.
5. Metals and their appropriate uses.
6. Sizes of drills.
7. Kinds and grades of tools and finishing materials.
8. Lacquers.
9. Formulas for coloring.
10. Pickling solutions.
11. Weights, sizes, and gages of sheet metals.
12. The history and uses of copper.
13. The mining and smelting of copper.
14. Rolling mill processes.
15. The spinning of metals.
16. Occupational opportunities.
17. Leisure time and social service activities.

HOME MECHANICS OPERATION UNITS

1. Mix and apply paint on old and new surfaces.
2. Apply lacquer and enamel.
3. Apply shellac and varnish.
4. Care for and clean brushes.
5. Lubricate a window sash that binds.
6. Replace sash cords and weights.
7. Make, repair and install window screens.
8. Cut and set glass.
9. Hang and repair window shades.
10. True up a door that sags or binds.
11. Set and adjust butt-hinges.
12. Adjust and repair door locks.
13. Stop floor boards from creaking.
14. Re-fit buckling linoleum.
15. Put hangers in plastered walls.
16. Repair holes in plastered walls.
17. Tighten loose joints on furniture.
18. Use corner braces and mending plates in repairing furniture.
19. Prepare and use different types of glue.
20. Put pulls on drawers.
21. Install drawer stops and glides.
22. Loosen drawers that stick.
23. Repair drawer bottoms.
24. Attach casters and glides.
25. Reseat chairs.
26. Do simple repair of upholstery.
27. Care for garden hose.
28. Install connections on garden hose.
29. Sharpen a hand sickle.
30. Sharpen a garden hoe or shovel.

31. Adjust and oil a lawnmower.
32. Sharpen knives.
33. Mix concrete.
34. Patch with concrete.
35. Put up a clothesline.
36. Care for tools to prevent rust.
37. Read gas, water, and electric meters.
38. Regulate mixer on gas burner.
39. Clean gas burners.
40. Install washers on water faucets.
41. Cut off water and drain pipes.
42. Remove stoppages from pipes.
43. Clean out traps and drains.
44. Care for house furnace.
45. Install electric bells.
46. Replace fuses.
47. Wire a socket and plug.
48. Install extension wall plug.
49. Read a working drawing.
50. Make a working sketch.
51. Develop habit of observing how jobs are done.
52. Plan a job.
53. Figure bill of material and cost.
54. Use hammer and nails.
55. Use corrugated fasteners.
56. Use a saw.
57. Use a cold chisel.
58. Use a wrench.
59. Use pliers and wire cutters.
60. Use a hand-drill.
61. Use a brace and bit.
62. Use a file.
63. Use a plane.
64. Use a try-square.
65. Use a rule.
66. Fit a tool handle.
67. Fasten with screws, nails, brads, or corrugated fasteners.
68. Shape a screwdriver tip.
69. Splice wire.
70. Repair a faucet.
71. Dismantle and reassemble pipes and pipe fittings.
72. Connect a gas stove.
73. Locate leak in gas line safely.
74. Clean out sink trap lines.
75. Remove paint or varnish.
76. Fit a tool handle—chisel, hatchet, axe.
77. Put a new rung in a ladder.
78. Sandpaper wood.
79. Polish metal.
80. Clean and care for paint-brushes.
81. Put a heating element in a grill or electric toaster.
82. Renew fuses in compliance with safety.
83. Solder tin, copper, and galvanized iron.
84. Replace a broken flush switch or base plug.
85. Plug in a floor lamp safely.
86. Join metal parts with rivets.
87. Cut metal with a hack saw, snips, shears, and cold chisel.
88. Draw file.
89. Clean a file with a file card.
90. Store or rack files and other tools.
91. Sharpen a cabinet scraper.
92. Cut a circular piece of glass (disk).
93. Paint window screens.
94. Drill holes in glass.
95. Lay roof covering-paper or shingle.
96. Clean paint pots or containers.
97. Thin or cut shellac, varnish, paint (inside and outside), and enamel.
98. Make putty.

HOME MECHANICS INFORMATION UNITS

1. Distinguish some of the more common woods, and know their principle characteristics and working qualities.
2. Protection and preservation of woods.
3. The effect of moisture on wood.
4. Nominal and actual standard dimensions of lumber.
5. The object of wood finishes.
6. Durability of different finishes.
7. Materials from which finishes are made.
8. Effect of moisture on finishes.
9. Kinds and sizes of nails.
10. How nails are sold.
11. Sizes of brads and how sold.
12. How screws are sized and sold.
13. Kinds of glue, how mixed, and uses.
14. Kinds and grades of sandpaper.
15. Grades and uses of steel wool.
16. Kinds of sharpening stones.
17. How sizes of auger and drill bits are indicated.
18. Sizes and kinds of bits and drills.
19. Name of pipe fittings.

20. Sizes and kinds of pipes and tubing.
21. Names of plumbing fixtures and fittings.
22. Why materials in pipes vary with their use.
23. Sizes of wire and kinds of wire. Use of gage.
24. Names and purposes of different kinds of wrenches.
25. Distinguishing characteristics of common metals.
26. Effect of heat on metal.
27. Safety habits relative to home appliances.
28. Gauges of sheet metal.
29. Safety of electrical appliances.
30. Safety of gas and water lines.
31. Which trees are most apt to clog sewer lines with roots.
32. Precaution in using chemicals in cleaning sewer lines and traps.
33. Effect of salt on metal.
34. Appreciation of sharp and well kept tools and equipment.
35. Expansion and contraction of materials, due to dryness, dampness, heat, cold.

Chapter XIII

FARM SHOP

The industrial arts program is not fundamentally vocational in its objectives, but based on the philosophy that school shop activities should be fitted to the vocational interest of a community. Farm Shop should be well adapted to the average rural community program in Kentucky. This does not necessarily mean that a certain amount of furniture making would not be just as vital as an industrial arts activity in the rural area as it would in the urban center, since the rural family is in need of a knowledge of furniture designing, construction, and selection, just as is the resident of any other section. On the other hand, the average farm boy is confronted with certain mechanical tasks which are slightly different than those confronting the boy attending the city school system. Consequently, the care and repair of hand tools and small farm implements as well as the more elaborate equipment such as farm machinery can well be added to the industrial arts program. Many of the Farm Shop units can be carried on in the form of a general shop and the organization of the shop may be determined to a certain extent by the local administrative and existing housing situation. Where feasible, a much more effective program could be set up with a building and physical equipment planned specifically to meet the community needs.

Specific Objectives

1. Develop skill in the use of tools.
2. Develop orderly thinking and doing habits.
3. Encourage habits of economy and thrift.
4. Enable the farmer to become more nearly self-sufficient and independent.
5. Develop a knowledge and appreciation for things mechanical.
6. Develop an interest in and understanding of materials such as wood, metals, paints, etc.
7. Furnish a working knowledge of drawing and reading drawings.

Farm Carpentry

OPERATION UNITS

1. Handle tools without abuse.
2. Protect working edges.
3. Prevent rusting.
4. Store tools.
5. Use handsaw (cross-grain).
 - a. Employ proper grip.
 - b. Hold at proper angle.
 - c. Start the saw cut.
 - d. Saw to a line.

6. Use nail hammer.
 - a. Drive nails.
 - b. Draw nails.
7. Use a rule, square, and tape-line for measuring to feet, inches, and quarter, eighth and sixteenth inches.
8. Use brace and bit.
 - a. Use proper grip.
 - b. Start bit.
 - c. Finish the hole.
 - d. Countersink for screws.
 - e. Set and use expansive bit.
9. Use and adjust planes.
 - a. Take plane down and re-assemble.
 - b. Adjust to depth and corners.
 - c. Use plane properly.
10. Use square as a straight edge, and to square a line.
 - a. Hold square.
 - b. Square a line.
 - c. Use square as a straight edge.
11. Use wood chisel.
 - a. Chisel with grain.
 - b. Chisel across grain.
12. Use marking gauge.
 - a. Employ proper grip.
 - b. Set gauge.
 - c. Use gauge.
13. Use rip saw.
14. Use draw knife.
15. Use wood rasp.
16. Use nail set.
17. Use screw drive.
18. Use sandpaper.
19. Use dividers.
20. Compass saw.
21. Hand drill.
22. Spoke shave.
23. Construct farm equipment made principally of wood.
24. Construct farm buildings.
25. Lay out foundations.
 - a. Square the lay-out to size.
 - b. Level the lay-out.
 - c. Build batting board corners.
 - d. Check the lay-out for dimensions, squareness, and levelness.
26. Build and place foundation forms.
 - a. Construct form.
 - b. Line up and level forms.
 - c. Brace forms.
 - d. Place bolts and nailing blocks.
27. Frame a building.
 - a. Cut out and lay sills.
 - b. Lay and brace joists.
 - c. Construct, erect, and plumb corners.
 - d. Erect and line studding.
 - e. Lay plates.
 - f. Brace framing.
 - g. Frame doors and windows.
 - h. Lay out, cut, and set rafters.
 - i. Lay out and build steps.
28. Side a building.
 - a. Put on storm sheathing.
 - b. Put on boxing, weather board, or composition siding.
29. Roof a building.
 - a. Sheath a roof.
 - b. Apply metal roof, composition roof, or shingles.
30. Floor a building.
 - a. Put on subfloor.
 - b. Joint, match, and lay finish floor.
31. Attach hinges, locks, and such.
32. Screen a building.
 - a. Construct screen frames.
 - b. Cut, stretch, and install wire.
 - c. Hang screen doors and windows.
33. Do such repair work as
 - a. Repair foundations.
 - b. Replace defective timbers.
 - c. Replace flooring and siding.
 - d. Repair leaky roof.
 - e. Rehang doors.
 - f. Replace window sash.
 - g. Repair and replace locks, hinges, etc.
 - h. Repair screens.
 - i. Replace window glass.
 - Remove broken glass.
 - Prepare sash.
 - Cut glass.
 - Prepare and apply putty.
34. Pull roofing, flooring and siding.
35. Take down framing.
36. Pull nails.
37. Sort and stack lumber.

INFORMATION UNITS

1. Read and interpret simple blueprints and drawings.
 - a. Understand scale.
 - b. Understand blueprints and drawings.
 - c. Determine dimensions.

- d. Interpret details.
- e. Make free-hand sketches.
- 2. Choose lumber and builders' hardware.
 - a. Select lumber.
 - b. Select builders' hardware.
 - Select lumber, bolts, rivets.
 - Select screws, hinges, door fastenings, and such.

- 3. Make out a working list of materials and check bill of materials.
- 4. Make out bills of materials for purchasing.
 - a. Estimate quantities and sizes.
 - b. Calculate board feet.
 - c. State bill of materials.
 - d. Figure cost.

Farm Tools

OPERATION UNITS

- | | |
|--|--|
| <ul style="list-style-type: none"> 1. Clean tools. 2. Decide what sharpening equipment to use. 3. Grind to proper angle with grindstone. 4. Use emery grinder. <ul style="list-style-type: none"> a. Grind to the proper angle. b. Prevent burning. c. Use emery wheel dresser. 5. Stone to cutting edge. <ul style="list-style-type: none"> a. Employ proper stroke. b. Remove wire edge. c. Test cutting edge. 6. Use files. <ul style="list-style-type: none"> a. Employ proper strike. b. Care for files. | <ul style="list-style-type: none"> 7. Clean saws. 8. Joint. 9. Shape and file teeth. 10. Set teeth. 11. Side joint. 12. Gum circle and timber saws. 13. Clean and sharpen auger bits and drill bits. 14. Fit handles in small tools. 15. Select or make the handle. 16. Fit handle. 17. Fasten the handle in place. 18. Finish the handle. |
|--|--|

INFORMATION UNITS

- | | |
|--|--|
| <ul style="list-style-type: none"> 1. Select hand tools. <ul style="list-style-type: none"> a. Select hand tools of proper size and design. b. Recognize quality of workmanship and materials. | <ul style="list-style-type: none"> Metal parts. Finish. c. Recognize trade names and brands. d. Understand guarantees. |
|--|--|

Leather Work

OPERATION UNITS

- | | |
|---|---|
| <ul style="list-style-type: none"> 1. Repair and care for harness. 2. Replace worn or broken straps. <ul style="list-style-type: none"> a. Cut to proper length and width. b. Make stitched splice. <ul style="list-style-type: none"> Prepare ends of strap for splicing. Prepare harness thread. Mark guide lines. Use stitching tools and do the stitching. c. Make riveted splice. <ul style="list-style-type: none"> Solid copper rivets. | <ul style="list-style-type: none"> 3. Replace worn or broken fittings. <ul style="list-style-type: none"> a. Select buckles, snaps, rings, clips, traces, etc. b. Attach fittings. 4. Clean and oil harness. <ul style="list-style-type: none"> a. Take harness apart. b. Soak and scrub the harness. c. Dry the harness. d. Apply harness oil. 5. Repair work shoes. 6. Restitch rips. |
|---|---|

7. Put on half soles.
 - a. Remove worn sole.
 - b. Prepare leather sole.
 - c. Trim new sole.
8. Replace rubber heels.
9. Repair leather heels.
10. Put on heel and toe plates.
11. Oil work shoes.

INFORMATION UNITS

1. Acquire a knowledge of leather and its qualities.
2. Select leather for various uses.
3. Knowledge of leather dressings.
4. How to care for leathers.

Fencing

OPERATION UNITS

1. Construct fences.
2. Locate lines and corners.
3. Line, space, and dig post holes.
4. Set, line, and tamp posts.
5. Brace corners, ends, and stretching posts.
 - a. Cut and place stiff braces.
 - b. Attach wire braces.
6. Unroll, cut, and splice wire.
7. Stretch wire.
8. Staple wire to post.
9. Space barbed wire.
10. Repair fences.
11. Splice and patch wire.
12. Take down and restretch wire.
13. Replace and reset posts.
14. Re-staple wire.

INFORMATION UNITS

1. Select and secure materials.
2. Determine amounts of material to secure.
3. Select fabricated wire fencing.
 - a. Understand wire gauges.
 - b. Understand wire spacings.
 - c. Recognize quality of workmanship and materials.
 - Galvanization.
 - Wire material.
 - Joints.
 - Expansion crimps.
 - d. Recognize trade names and brands.
 - e. Understand type of fencing for different uses.
 - General.
 - Poultry.
4. Select smooth and barbed wire.
5. Select staples.
 - a. Length.
 - b. Wire gauge.
6. Select, secure, and treat posts.
 - a. Lasting qualities.
 - b. Size for line, ends, and corners.
 - c. Lengths.
 - d. Preservatives.
 - e. Value of peeling posts.
 - f. Comparative costs.
7. Select and secure braces.
8. Select and secure fencing tools.

Sheet-Metal

OPERATION UNITS

1. Make sheet-metal appliances.
2. Decide on design and kind of joints.
3. Measure and lay out stock.
4. Bend and shape sheet metal.
5. Cut sheet metal.
6. Make joints.
7. Drill, punch, and rivet.
8. Do soldering.
9. Operate blowtorch.
10. Tin soldering coppers.
11. Heat soldering iron.
12. Clean and prepare metal for soldering.
13. Select and use fluxes.

14. Apply soldering to tin, iron, and steel, copper, and brass, lead, aluminum.
15. Repair roof and such appliances as milk cans and buckets.
16. Solder open seam or crack.
17. Repair small hole.
18. Patch large hole.
19. Patch small hole.
20. Remove excess soldering.

INFORMATION UNITS

1. Acquire a knowledge of sheet metals.
2. Sheet-metal layouts.
3. Preservation of sheet metals.
4. Solders and their uses.

Plumbing

OPERATION UNITS

1. Install plumbing.
2. Measure pipe.
3. Cut pipe.
 - a. Pipe cutter.
 - b. Hack saw.
4. Ream pipe.
5. Thread pipe.
6. Connect pipe and fittings.
7. Install a pitcher pump or well pump.
8. Keep plumbing in repair.
9. Repair a broken pipe.
10. Replace faucet washers.
11. Clean out traps and drain pipe.
12. Protect plumbing against freezing.
13. Thaw out frozen pipes.

INFORMATION UNITS

1. Select and secure plumbing materials and fixtures.
2. Determine the kind, size, and amount of pipe.
3. Determine the kind, number, and size of such fittings as elbows, T's, unions, reducers, caps, plugs, valves, and faucets.
4. Select such plumbing fixtures as lavatory, bath-tubs, sinks, and toilets.
5. Estimate costs of plumbing materials for a job.

Painting

OPERATION UNITS

1. Apply paint, whitewash, etc.
2. Apply paint.
 - a. Prepare surface.
 - b. Mix to proper consistency.
 - c. Apply first, second, and third coats.
3. Paint roofs.
4. Apply home-made paints.
5. Apply whitewash.
6. Prepare home-mixed paints, whitewash, etc.
7. Prepare lead base paint.
8. Prepare red metallic iron oxide paint.
9. Prepare crankcase oil paint.
10. Prepare whitewash.
11. Care for brushes.
12. Keep brushes without cleaning, for short periods.
13. Clean brushes.
14. Store brushes.

INFORMATION UNITS

1. Plan the work.
2. Determine the need for painting, etc.
3. Decide on the kind of material to use.
4. Determine the amount of material needed.
5. Select and secure materials and equipment.
6. Select and secure brushes.
 - a. Kind.
 - b. Size.
 - c. Quality.

7. Select ready-mixed paint.
 - a. Determine quality.
 - Lead content.
 - Zinc content, oil content.
8. Understand trade names and brands.
9. Choose color.
10. Select and secure solvents and thinners, as linseed oil, turpentine, etc.
11. Select and secure materials for home mixing.
 - a. Paint.
 - b. Whitewash.
 - c. Concrete paint.
 - d. Home-made preservatives.

Tractor, Truck, and Automobile Unit

OPERATION UNITS

1. Operate tractor, truck, and auto.
2. Start motor.
 - a. Start cold motor.
 - b. Start hot motor.
 - c. Warm-up motor.
 - d. Determine and correct cause of starting trouble.
3. Drive truck and automobile.
 - a. Start and drive.
 - Change gears.
 - Steer.
 - Apply brakes.
 - Stop.
 - Back up.
 - Park.
 - b. Observe traffic signs.
 - c. Observe rules of safety.
4. Drive a farm tractor.
 - a. Start, drive, stop, and back up.
 - Unloaded.
 - Normal load.
 - Heavy load.
 - On slippery surface.
 - b. Hitched to farm equipment.
 - c. Pull farm equipment.
 - d. Pull belt-driven equipment.
 - Line up for belt.
 - Adjust to proper belt tension.
 - Pull at the proper speed.
5. Service tractor, truck, auto.
6. Service the cooling system.
 - a. Adjust fan belt.
 - b. Clean cooling system.
 - c. Prevent freezing.
 - d. Replace radiator hose.
 - e. Repair leaky radiator.
7. Service fuel system.
 - a. Clean gasoline line.
 - b. Adjust carburetor.
8. Service ignition system.
 - a. Service battery.
 - b. Locate and repair short circuits.
 - c. Clean and adjust spark plugs.
 - d. Adjust headlights and replace bulbs.
 - e. Install fuses.
9. Do general lubrication.
 - a. Select lubricants.
 - b. Change motor oil.
 - c. Operate grease gun.
 - d. Lubricate the different parts of the machine.
10. Service tires.
 - a. Remove, inspect, and replace tires.
 - b. Select and install boots.
 - c. Repair inner tubes and valves.
 - d. Inflate tires.
11. Service brakes.
 - a. Adjust brakes.
 - b. Reline brakes.

INFORMATION UNITS

1. Understanding the principles of:
 - a. Internal combustion motors.
 - b. Transmission.
 - c. Differential.
 - d. Braking systems.
 - e. Lighting and dimming.

Electricity

OPERATION UNITS

1. Do simple house wiring.
2. Plan circuits.
3. Install wire.
 - a. BX cable.

- b. Rigid conduit.
- c. Romex cable.
4. Install outlet boxes.
5. Install switches.
6. Circuit breakers.
7. Make and attach drop cords.
 - a. Make box connection.
 - b. Attach sockets.
8. Make an extension.
9. Hang and connect light fixtures.
10. Install and connect electric motors.
11. Operate and care for electric motors.
12. Start and stop motor.
13. Oil motor.
14. Clean and replace motor brushes.
15. Care for motors.
16. Keep wiring and equipment in repair.
17. Replace fuses.
18. Replace switches, cutouts, and relays.
19. Repair extension cords, drop cords, etc.
20. Repair sockets.
21. Understand some of the principles of electricity.
22. Ohm's law.
23. Transformer.
24. Electro-magnet.
25. Direct current.
26. Alternating current.
27. Resistance.
28. Motor.
29. Generator.
30. Incandescent light.

INFORMATION UNITS

How to:

1. Select materials and equipment—wire, switches, fuse boxes, outlet boxes, conduit, circuit breakers, electric motors.
2. Read meters.

Rope Work

OPERATION UNITS

1. Tie useful knots, hitches, and splices.
2. Whip the end of a rope.
3. Tie useful knots, as
 - a. Overhand.
 - b. Square.
 - c. Weaver's.
 - d. Binder twine.
 - e. Slip.
 - f. Bowline.
 - g. Sheep shank.
 - h. Miller's.
4. Tie useful hitches, as
 - a. Half hitch.
 - b. Blockwell.
 - c. Timber.
 - d. Scaffold.
 - e. Well-pipe.
 - f. Clove.
 - g. Throwing.
 - h. Manger.
5. Tie useful splices, as
 - a. Crown or end.
 - b. Eye or side.
 - c. Short.
 - d. Long.
6. Repair a broken strand in a rope.
7. Make rope halters, as
 - a. Temporary.
 - b. Adjustable.
 - c. Non-adjustable.
8. Reeve a block and tackle.
9. Care for rope.
 - a. Treatment.
 - b. Storage.

INFORMATION UNITS

How to:

1. Secure rope.
2. Decide on the kind, size, and amount of rope needed.
3. Buy rope.
4. Make rope.
 - a. Make rope-making machine and equipment.
 - b. Select and secure twine.
 - c. Make the rope.

Concrete and Masonry

OPERATION UNITS

1. Do concrete construction.
2. Lay out the work.
3. Do the excavation.
4. Place reinforcing steel.

5. Build and set forms.
6. Mix concrete.
 - a. Measure the aggregate.
 - b. Mix concrete.
7. Pour concrete.
8. Finish concrete.
9. Cure concrete.
10. Waterproof concrete.
11. Remove and clean forms.
12. Do concrete plastering.
13. Care for concrete tools.
14. Repair concrete and plaster.
15. Repair surface or place.
16. Mix materials for making the patch.
17. Apply the patch.
18. Do stone or brick construction.
19. Select materials.
20. Lay out the work.
21. Shape stone.
22. Lay stone or brick.
23. Point or strike joints.

INFORMATION UNITS

How to:

1. Plan the work.
 2. Decide on blueprint or drawing to use.
 3. Secure materials.
 - a. Estimate amount of materials.
 - b. Test material.
- Stone or brick, gravel, sand, cement, form material.
- Sand and gravel content of bank gravel; silt content of sand.

Farm Machinery Repair

OPERATION UNITS

1. Do forge work.
2. Build and maintain a forge fire.
3. Choose stock for different kinds of work.
4. Measure and cut stock.
5. Heat to the proper temperature.
 - a. Secure the proper fire.
 - b. Place stock in position.
 - c. Bank fire around stock.
 - d. Turn blower at the correct speed.
 - e. See that the piece is heated properly.
 - f. Heat the stock to the desired heat.
6. Draw out or sharpen stock.
 - a. Bring the stock to the proper heat.
 - b. Draw out or sharpen on the anvil horn.
 - c. Finish the stock on the anvil face.
7. Upset or enlarge stock.
 - a. Bring the stock to the proper heat.
 - b. Strike the stock to cause it to enlarge.
 - c. Prevent enlarging where not desired.
8. Bend or twist stock.
 - a. Bring stock to the proper heat.
 - b. Use vise to hold stock for twisting.
 - c. Cause the stock to twist uniformly.
 - d. Bend stock on the anvil.
9. Make simple welds.
 - a. Secure proper fire.
 - b. Enlarge stock where weld is to be made.
 - c. Scarf portions to be welded.
 - d. Apply welding compound. Before heating. During heating.
 - e. Bring stock to the proper heat.
 - f. Weld the pieces together.
10. Punch hot metal.
11. Temper tools.
 - a. Bring stock to the proper heat.
 - b. Cool the stock.
 - c. Polish stock with emery cloth or sandstone.
 - d. Observe the colors as they form.
 - e. Plunge in water when the desired color is reached.
 - f. Test tool for proper temper.
12. Use cold-metal working tools.
13. Use hacksaw.
14. Use cold chisels.
15. Use metal drills.
 - a. Locate and mark point at which hole is to be drilled.
 - b. Center-punch hold for drilling.
 - c. Employ proper procedure in drilling.

16. Sharpen drill bits.
17. Use taps and dies.
 - a. Cut threads in nuts.
 - b. Cut threads in bolts.
18. Do metal riveting.
19. Bend cold metal.
20. Overhaul and repair farm machinery.
21. Inspect the machine for worn, broken, or loosened parts.
22. Replace worn or broken parts.
 - a. Make repairs in parts when practical to make them.
 - b. Buy parts that should not be made at home.
 - c. Remove worn or broken parts.
 - d. Put in new parts.
23. Tighten bolts, rivets, and screws.
24. Clean the machine of rust.
25. Adjust machine for efficient work.
26. Sharpen cutting edges.
 - Disk.
 - Shovels.
 - Teeth.
 - Blades.
 - Points.
27. Paint the machine.
28. Store machinery.
29. Clean the machinery before storing.
30. Oil or grease all parts not painted.
31. Paint parts where needed.
32. Place in tool shed.

INFORMATION UNITS

How to:

1. Plan the work.
2. Decide when to do the work.
3. Determine what repairs are needed.
4. Decide whether to make or buy repair parts.
5. Order repair parts.

APPENDIX A

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Farm Terracing, Farmers' Bulletin 1669.
A Simple Inexpensive Farm Level, Minnesota Circular 36.
Soil Erosion and Its Control, Kentucky Circular 304.
Earth Dams for Farm Reservoirs, Kentucky Circular 317.

Leather Work

- Repairing Farm Harnesses*, Cornell Bulletin 225.

Machinery Repair

- Operation, Care, and Repair of Farm Machinery*.
Morrison, *Repairing Farm Machinery*. The Interstate, Danville, Illinois.
Care and Repair of Mowers and Binders, Farmers' Bulletin 1754.
The Adjustment and Repair of Mowers, Iowa Bulletin 192.
Care and Repair of the Mowing Machine, Michigan Extension Bulletin 153.
Farm Machinery, Its Purchase, Care, Operation, and Adjustment, Illinois Circular 329.
The Simplex Lime Spreader, Michigan Circular 62.

Painting and Wood Finishing

- Jeffery, *Wood Finishing*. Manual Arts Press, Peoria, Illinois.
Painting the Exterior of the House, Kentucky Circular 241.
Selecting and Applying Paints, Iowa Extension Circular 261.
Whitewash and Cold Water Paints, National Lime Association Bulletin 3040.
Touching Up Old Furniture, Kentucky Circular 199.
Natural Woods and How to Finish Them, Berry Brothers, Detroit, Mich.
Outside Paints and Painting, Iowa Extension Circular 227.
The Handbook on Painting, National Lead Company.

Plumbing

- Wright, *Rural Water Supply and Sanitation*. John Wiley and Sons, New York.
Pitcher Pump Installation, Kentucky Circular 125.
Electrically Operated Water Systems for Farms, Kentucky Circular 319.
The Hydraulic Ram, Kentucky Circular 246.
Septic Tanks for Sewage Disposal, Kentucky Circular 131.
Simple Plumbing Repairs in the Home, Farmers' Bulletin 1460.
Farm Plumbing, Farmers' Bulletin 1426.
Farmstead Water Supply, Farmers' Bulletin 1448.

Rope Work

- Rope and Its Uses*, Massachusetts Leaflet 139.
Rope and Its Uses, Iowa Extension Bulletin 24.
Rope and Its Uses, North Dakota Circular 144.
Rope Work, Minnesota Special Bulletin 192.

Sheet Metal Work

Lukowitz, J. J., *Fifty-five New Tin Can Projects*. Bruce Publishing Company, Milwaukee, Wisconsin.

Tool Fitting

Coggins, Armstrong, and Giles. *A Manual on Sharpening Hand Woodworking Tools*. The Manual Arts Press, Peoria, Illinois.

Grinding Farm Tools, Cornell Extension Bulletin 155.

How to Sharpen Woodworking Tools, The Carborundum Company, Niagara Falls, New York.

APPENDIX C

Magazines and Periodicals for Industrial Arts Teachers and Students

- The Delta*gram. The Delta Manufacturing Company, Milwaukee, Wisconsin (sub. \$.50).
- Furniture Manufacturer*. Vincent Edwards and Company, New York (sub. \$2.00).
- Hobbies*. Society of Philatelic Americans, Chicago, Illinois (sub. \$2.00).
- Home Craftsman*. Home Craftsman Publishing Corporation, New York (sub. \$1.25).
- Industrial Arts and Vocational Education*. Bruce Publishing Company, Milwaukee, Wisconsin (sub. \$3.00).
- Model Airplane News*. Jay Publishing Company, New York (sub. \$1.25).
- Modelmaker*. Modelmaker Corporation, Mauwatosa, Wisconsin (sub. \$1.50).
- Occupations*. The Vocational Guidance Magazine, National Vocational Guidance Association, New York (sub. \$3.50).
- Popular Homecraft*. General Publishing Company, Chicago, Illinois (sub. \$2.00).
- Popular Mechanics*. Popular Mechanics Company, Chicago, Illinois (sub. \$2.50).
- Popular Science Monthly*. Popular Science Publishing Company, New York (sub. \$2.50).
- School Arts Magazine*. Davis Press, Worcester, Massachusetts (sub. \$3.00).
- School Life*. U. S. Office of Education, Federal Security Agency, Washington, D. C. (sub. \$1.00).
- School Shop*. Box 100, Ann Arbor, Michigan (sub. \$2.00).

APPENDIX D

Sources of Industrial Arts Supplies and Equipment

Abrasives:

Behr-Manning Corp.
1948 Chamberlain Street
Troy, New York.

The Carborundum Co.
Niagara Falls, N. Y.

Casco Products Corp.
512 Hancock Avenue
Bridgeport, Connecticut.

Norton Company
1 New Bond Street
Worcester 6, Massachusetts.

Pittsburgh Plate Glass Co.
632 Duquesne Way
Pittsburgh, Pennsylvania.

Thurston Supply Co.
Anoka, Minnesota.

Wausau Abrasive Co.
1500 S. Western Ave.
Chicago, Illinois
Wausau, Wisconsin.

Automotives:

Black & Decker Tool Co.
600 E. Pennsylvania Ave.
Towson, Maryland
New York, N. Y.
Chicago, Illinois
Detroit, Michigan
Minneapolis, Minn.

Bradhead-Garrett Co.
Cleveland 5, Ohio.

The Cincinnati Tool Co.
4059 Montgomery Rd.
Cincinnati 12, Ohio.

Eau Claire, Auto Supply Co.
Eau Claire, Wisconsin.

Hammacher Schlemmer
4th Ave. at 13th
New York, N. Y.

The New Britain Machine Co.
New Britain, Connecticut

Snap-On-Tools, Inc.
Kenosha, Wisconsin
San Francisco, Calif.
New York, N. Y.
Atlanta, Ga.
Chicago, Illinois.

South Bend Lathe Works
181 E. Madison Street
South Bend 22, Indiana.

Stanley Tool Works
New Britain, Connecticut

L. S. Starrett Tool Co.
101 Crescent Street
Athol, Massachusetts.

Western Iron Supply Store
145-147 W. Water Street
Milwaukee, Wisconsin.

Cements:

Bold Blatt Tool Co.
1522 Walnut Street
Kansas City, Missouri.

Casein Co. of America
350 Madison Avenue
New York 17, New York.

Franklin Glue Co.
119 W. Chestnut Street
Columbus 15, Ohio.

Geo. B. Smith Chemical Co.
Springfield, Illinois.

United States Gypsum Co.
302 W. Adams Street
Chicago, Illinois
(in all principal cities).

United States Plywood Corp.
55 W. 44th Street
New York 18, New York.

Crafts:

American Handicrafts Co., Inc.
45-49 S. Harrison Street
East Orange, New Jersey.

Boy Scouts of America
9 Washington Street
Chicago, Illinois

Bradhead-Garrett Co.
Cleveland 5, Ohio.

William Dixon, Inc.
36 E. Kenney Street
Newark, N. J.

Eagle-Ottawa Leather Co.
205 Ellis Street
Grand Haven, Michigan
Chicago, Illinois
St. Louis, Missouri
New York, New York
Boston, Massachusetts
San Francisco, California.

Fry Plastics Company
7606 S. Vermont Avenue
Los Angeles 44, California.

Grayton & Knight
Worcester, Massachusetts.

Hobby Club Supply Company
Janesville, Wisconsin.

Indian Archery & Toy Co.
Evansville, Indiana

Lackawanna Leather Co.
Hackettstown, N. Y.

Leather Craft Supply Company
Amos Station, Omaha, Nebraska.

Lowe & Campbell
1509 Baltimore
Kansas City, Mo.
Chicago, Ill.
Minneapolis, Minn.
Dallas, Texas
Cincinnati, Ohio.

Metal Crafts Supply Company
10 Thomas Street
Providence 3, Rhode Island

New York Moulding Rubber Co.
Box 93

Brooklyn 9, New York.

Spalding & Bro., Inc.
105 Nassau St.
New York, N. Y.
(in all principal cities).

The Waldcraft Co.
Indianapolis, Indiana.

Drawings:

American Blue Print Paper Co.
445 Plymouth Ct.
Chicago, Illinois.

Eugene Dietzgen & Co.
2425 Sheffield Ave.
Chicago, Illinois
Milwaukee, Wisconsin
Pittsburgh, Pennsylvania
Los Angeles, California
New Orleans, Louisiana.

Joseph Dixon Crucible Co.
167 Wayne Street
Jersey City 3, New Jersey.

Keuffel & Esser Co.
300 Adams Street
Hoboken, N. J.
New York, N. Y.
Chicago, Ill.
St. Louis, Mo.
San Francisco, California.

The C. F. Pease Co.
802 N. Franklin St.
Chicago, Illinois.

Frederick Post. Co.
310 S. Michigan Ave.
Chicago, Illinois
Milwaukee, Wisconsin.

E. H. Sheldon & Co.
Laboratory Furniture
149 Thomas Street
Muskegon, Michigan.

U. S. Blue Print Paper Co.
207 S. Wabash Ave.
Chicago, Illinois.

F. Weber Co.
1220 Buttonwood St.
Philadelphia 23, Pennsylvania.

Electricity:

Allis Chalmers Mfg. Co.
427 East Stewart
Milwaukee, Wisconsin.

Boice-Crane Co.
930 W. Central Ave.
Toledo 6, Ohio.

Bradhead-Garrett Co.
Cleveland 5, Ohio.

Central Scientific Co.
456-30 E. Ohio St.
Chicago, Illinois
New York, N. Y.
Los Angeles, Calif.
Boston, Mass.

Fairbanks Morse & Co.
900 S. Wabash Ave.
Chicago, Illinois

General Electric Co.
River Road
Schenectady, N. Y.
(in all principal cities).

Graybar Electric Co., Inc.
1501 Graybar Building
New York, N. Y.
(in all principal cities).

Lusky, White & Coolidge
69 W. Lake St.
Chicago, Illinois.

The Norton Electrical Instru-
ment Co.
45 Hilliard St.
Manchester, Connecticut.

Prest-O-Lite Storage Battery
508 N. Capitol Ave.
Indianapolis, Ind.

Radio-Wire and Television Co.
Atlanta, Georgia
U. S. L. Battery Corp.
1725 Highland Ave.
Niagara Falls, N. Y.

Simmons Machine Tool Corp.
N. Broadway
Albany 1, New York.

Wagner Electric Corp.
6410 Plymouth Ave.
St. Louis, Missouri.

Walker-Turner Co., Inc.
Plainfield, New Jersey.

Western Electric Co.
Chicago, Illinois.

Westinghouse Electrical
& Mfg. Co.
East Pittsburgh, Pa.
(in all principal cities).

Metal Work:

Armstrong Bros. Tools Co.
317 N. Francisco
Chicago, Illinois.

E. C. Atkins, Inc.
Indianapolis, Ind.

Behr-Manning Corp.
1948 Chamberlain St.
Troy, New York.

Brown & Sharpe Co.
Promenade St.
Providence, R. I.

Buffalo Forge Co.
494 Broadway
Buffalo, N. Y.

H. Channon Co.
149 N. Wacker Drive
Chicago, Illinois.

Phillip Cross Hardware Co.
Milwaukee, Wisconsin.

Henry Disston & Sons
Tacony, Philadelphia 35, Pa.

William Dixon, Inc.
3226 E. Kinney St.
Newark, N. J.

Graham Mfg. Co.
46 Bridge St.
East Greenwich, Rhode Island.

Gray Mills Co.
1948 Ridge Rd.
Evanston, Illinois.

Le Blond Machine Tool Co.
Madison Rd. & Edwards Blvd.
Cincinnati, Ohio.

Lufkin Rule Co.
Saginaw, Michigan.

Lusky, White & Coolidge, Inc.
65 W. Lake St.
Chicago, Illinois.

Metal Crafts Supply Co.
37 Aborn St.
Providence, R. I.

Millers Falls Co.
Millers Falls, Mass.

New Britain Machine Co.
New Britain, Connecticut.

Niagara Machine & Tool Work
635 Northland Ave.
Buffalo, N. Y.

Peck, Stow & Wilcox Co.
Railroad Ave.
Southington, Conn.

The Pewtercrafters
29 Medow Ave.
Bronxville, N. Y.

Rockford Drilling Machine
Rockford, Illinois.

Sherwin-Williams Paint Co.
601 Canal Road
Cleveland, Ohio.

South Bend Lathe Works
500 E. Madison St.
South Bend, Indiana.

Stanley Rule & Levee Co.
New Britain, Conn.

L. S. Starrett Co.
101 Crescent St.
Athol, Massachusetts.

Western Iron Stores Co.
145-147 W. Water St.
Milwaukee, Wisconsin.

White Metal Rolling and Stamp-
ing Co.
95 Reynolds Ave.
Providence, R. I.
80 Calyer & Moultrie St.
Brooklyn, N. Y.

Miscellaneous Supplies:

Algoma Plywood & Veneer Co.
Algoma, Wisconsin.

Cleveland Model Airplane
Supply Co.
1866 W. 57th St.
Cleveland, Ohio.

Grand Rapids Fibre Cord Co.
609 Myrtle St.
N. W. Grand Rapids, Mich.

Heywood Wakefield Co.
148 N. 10th Street
Portland, Oregon.

Klise Manufacturing Co.
Grand Rapids, Michigan.

The Upholstery Supply Co.
1031-35 N. Fourth Street
Milwaukee, Wisconsin.

United States Plywood Corp.
55 W. 44th Street
New York 18, New York.

Wire:

American Steel & Wire Co.
208 LaSalle St.
Chicago, Illinois.

Woodworking:

Aetna Plywood-Veneer Co.
1705 Elston Ave.
Chicago, Illinois.

American Cabinet Hdw. Co.
418 S. Main St.
Rockford, Illinois.

American Glue Co.
121 Beverly
Boston, Mass.

American Wood Carving Co.
2337 N. Greenview Ave.
Chicago, Illinois.

Bakelite Products Co., Inc.
1300 Athens Ave.
Cleveland, Ohio
Crete, Illinois.

Behr-Manning Corp.
1948 Chamberlain St.
Troy, New York.

Berry Brothers, Inc.
"Berrycraft" Products
Detroit, Michigan.

Bradhead-Garrett Co.
Cleveland, Ohio.

Buck Brothers
Millbury, Massachusetts.

The Casein Mfg. Co.
"Casco" Glue
13 Park Row
New York, N. Y.

Commercial Delcomania Co.
200 Fifth Ave.
New York, N. Y.

Craftsman Wood Service Co.
2727 S. Mary St.
Chicago, Illinois.

Phillip Cross Hdw. Co.
Milwaukee, Wisconsin.

Decorator's Supply Co.
2547 S. Archer Ave.
Chicago, Illinois.

Delta Mfg. Co.
Rockwell Mfg. Co.
600 E. Vienna Ave.
Milwaukee 1, Wisconsin.

DeVoe-Reynolds Co., Inc.
1 W. 47th St.
New York, N. Y.
Tulsa, Oklahoma.

DuPont de Nemours & Co.
Paint & Duco Division
Philadelphia, Pa.
Chicago, Ill.
Brooklyn, N. Y.
San Francisco, Calif.

T. A. Foley Lumber Co.
Paris, Illinois.

Grand Rapids Wood Finishing
Co.
63 Ellsworth St.
Grand Rapids, Michigan.

Greenlee Brothers
Rockford, Illinois.

Hammacher-Schlammer Co.
4th Ave. and 13th St.
New York, N. Y.

S. C. Johnson & Co.
Racine, Wisconsin.

Klise Mfg. Co.
60 Cottage Grove
Grand Rapids, Mich.

Lowe Brothers Co.
450-52 E. Third St.
Dayton, Ohio.

Lusky, White & Coolidge.
65-71 W. Lake St.
Chicago, Illinois.

Benjamin Moore Paint Co.
231 First St.
Brooklyn, N. Y.
Chicago, Illinois
Philadelphia, Pa.
St. Louis, Mo.

Oliver Machinery Co.
500 W. Washington Blvd.
Chicago, Illinois
Grand Rapids, Michigan.

Ornamental Furniture Hardware
Rockford, Illinois.

Frank Paxton Lumber Co.
Kansas City, Kansas
Denver, Colorado.

Pittsburgh Plate Glass Co.
Pittsburgh, Pennsylvania
Tulsa, Oklahoma
Buffalo, N. Y.

Russia Cement Co.
"Le Pages" Glue.
Gloucester, Mass.
Chicago, Illinois
Reade, N. Y.

Sargent & Co.
Water & Wallace St.
New Haven, Conn.

Sherwin-Williams Co.
Cleveland, Ohio
Newark, N. J.
Rockford, Ill.

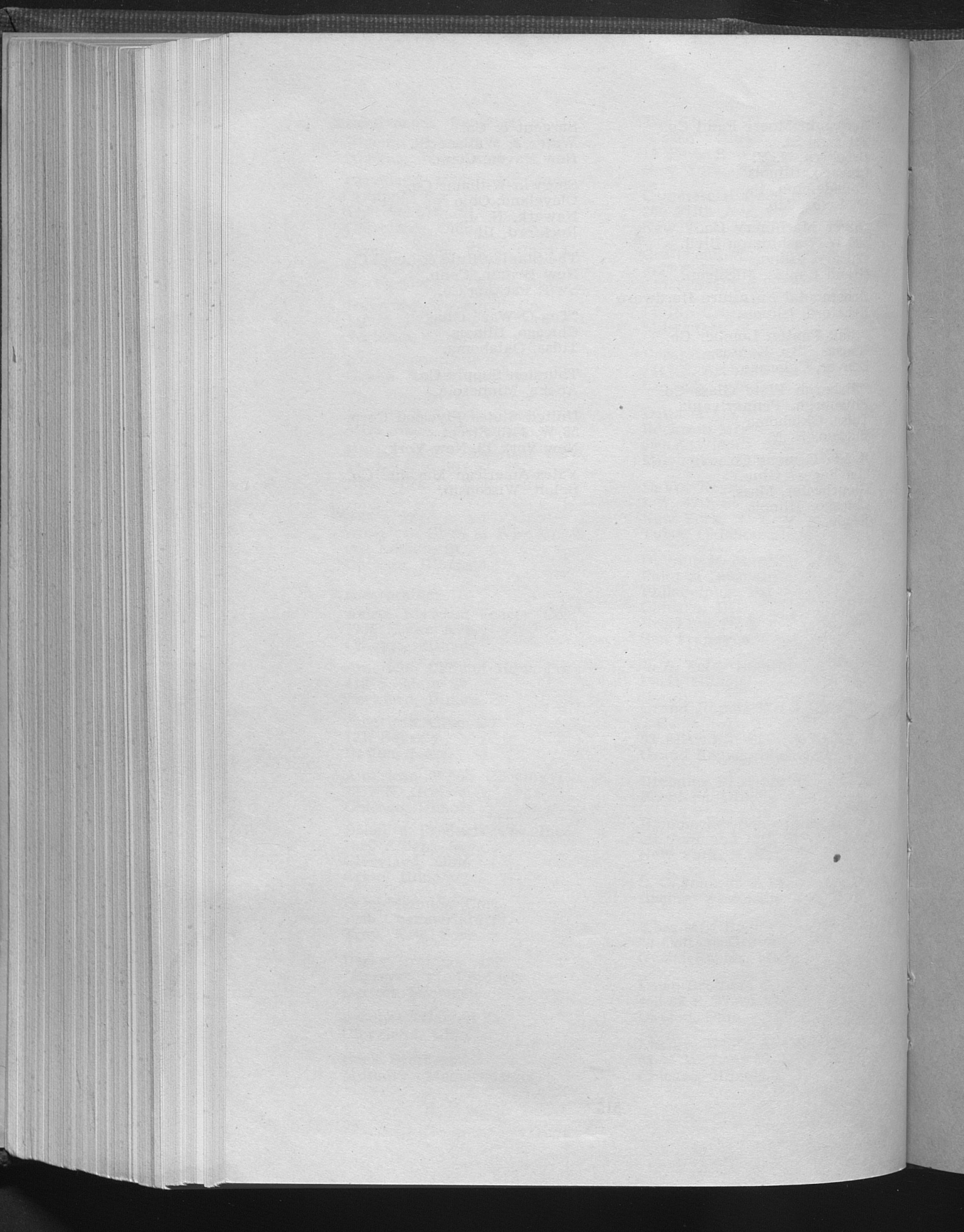
The Stanley Rule & Level Co.
New Britain, Conn.
Swift Packing Co.

"Tug-O-War" Glue
Chicago, Illinois
Tulsa, Oklahoma.

Thurston Supply Co.
Anoka, Minnesota.

United States Plywood Corp.
55 W. 44th Street
New York 18, New York.

Yates-American Machine Co.
Beloit, Wisconsin.





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