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INDUSTRIAL ARTS FOR ITUCKY HIGH SCHOOLS

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JOHN W. BROOKER
Superintendent of Public Instruction

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FOREWORD

There has long existed in this State a need for a more unified and coordinated curriculum in the field of industrial arts. The content of courses offered in this field has varied so greatly that it frequently has been difficult to evaluate credits submitted by students from the various high schools of the State. To the end that this problem might be given consideration and an enriched curriculum developed, I appointed the following to comprise the membership of a State Industrial Arts Curriculum Committee:

Mark Godman, State Department of Education, Chairman
L. T. Smith, Western State Teachers College, Bowling Green
Ralph Whalin, Eastern State Teachers' College, Richmond
Leonard Daugherty, Public Schools, Louisville
H. L. Oakley, Public Schools, Lexington
David M. Wherry, Public Schools, Dayton
Edwin B. Hundley, Public Schools, Louisville

It was the responsibility of this committee to develop a curriculum in industrial arts for use on a state-wide basis. In developing the curriculum which is found in this bulletin the state committee enlisted the aid and cooperation of more than forty teachers of industrial arts, representing high schools of all sections of the State. It is regretted that space will not permit the mention of all who gave of their time and energy to this publication.

The State Department of Education feels deeply indebted to all who have contributed to this enterprise. I believe that the contents of this bulletin represents a definite step forward in industrial arts education in Kentucky. It is not intended that the contents be followed verbatim, but rather, it is hoped that the bulletin may serve to unify and better coordinate the work in industrial arts in the high schools of this State.

JOHN W. BROOKER
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 time 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."*

In our own public schools the influence of Calvin M. Wood-

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

ward's efforts toward the establishment of a manual training program at St. Louis, and Dr. John D. Runkel's effort in Boston about 1877 were 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. Since only about 30% of our high school graduates in Kentucky enroll in college it would seem to be our responsibility to provide the other 70% 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 and is rapidly becoming more so. The war in which we are now engaged is almost entirely mechanized, and it is teaching us the importance of providing youth with an educational program which is more in keeping with conditions existing in his own society rather than those obtaining three hundred or more years ago. 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 if they make provisions for a wider and more varied program of industrial education for both boys and girls. The industrial arts shops should now be opened to girls as well as boys.

Trade schools should offer courses to girls in drafting, sheet metal, machine shop, automotive mechanics, aeronautics, printing, and woodwork. Some thought should be given now to the preparation of vocational courses for men who have been and will be wounded during the war. 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, will need some type of training during the post-war period in order to rehabili-

tate them and enable them to become self-sustaining. An enlarged and secific industrial education program through the public schools will be the solution of this serious 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 experiences.

Definition of Industrial Arts Education

Teachers are urged to keep clearly in mind the fundamental difference between industrial arts education and vocationol 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."*

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

* Monroe, W. S. *Encylopedia of Educational Research.* P. 602. The Macmillan Company, New York, 1941.

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 limitation of time and the difficulties in getting together the committee members, who live in all sections of the State, and many of whom are busily engaged on the National Defense Training Program after their daily teaching duties have been discharged, have seriously handicapped the State Committee in the preparation of this material. It is hoped that, in spite of all the difficulties, the reader will find some helpful suggestions for his use.

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 conmon 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 apitudes 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) make wise selection and proper use of food; (4) understand, and apply as far as possible, the appropriate selection of clothing as it affects health;

(5) be more intelligent about cleanliness and sanitation around the home; (6) learn how to conserve and gain strength and muscular control through manual activities; (7) become familiar with occupational dangers and health hazards; (8) learn occupational safety precautions; and (9) 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 in (a) caring for food products economically, (b) caring for and repairing clothing, and (c) 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 all. 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 probable 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 relationships 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 specifically, 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.

Dean M. Schweickard—Industrial Arts in Education.

Chapter III

INDUSTRIAL ARTS 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 recent 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 education program is under consideration.*

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 one industrial 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 assistant.

Teacher Qualifications. Great stress has been placed on the importance of the teacher in carrying out these necessary administrative duties. Certain qualifications are desirable of 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. 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.
4. A wide range of information concerning tools, materials, processes, products, and problems of occupational life, in industry.

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

5. Ability to distinguish between poor design and good design in industrial products, and to design shop projects which are structurally sound and aesthetically pleasing.
6. A sense of neatness and orderliness with respect to shop housekeeping.**

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 rather too limited in its scope for satisfactory use in an industrial arts program.

Time Allotment and Credits. 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 sixty-minute periods per week as the standard for the industrial arts program.

Schools not now using the sixty-minute period will find it rather difficult if not impossible 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 these institutions of higher learning. This committee urgently recom-

** "Industrial Arts Handbook", Bulletin 7B, Secondary School Series, State Dept. of Education, Jefferson City, Mo., 1941.

mends that industrial arts be placed upon the same credit basis as the traditional 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 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 stations provided."

Several state groups recommend that fifty square feet of floor space 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. Since Kentucky has many of both, there has been a slow expansion of industrial arts programs throughout the state.

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 seems to be 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. Each case will have to be decided upon its merit. The teacher training institutions are giving a program in shop organization and classroom management to every student who majors in industrial arts which equips him to successfully adapt his program to meet the local needs and conditions.

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, year, a list of the units 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 possibly 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 classifies 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 stock rooms 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 necessary that the teacher present adequate, safe machine operating instructions to the newcomers; 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; discourage "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 a case history in dealing with serious accidents. In this latter sense, a bulletin entitled, "Teacher Liability for Pupil

Injuries'', will aid in answering the legal questions of the harassed teacher or administrator, in whose shop has occurred a serious mishap.**

** "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 need 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 assit.

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 equiment that might 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 shop building may be of cheaper construction and lower insurance rates are possible, but unless a central heating system is used the 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 what noise 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 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 sq. ft. should be allowed 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 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 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. All concrete floors, plastered walls, and ceilings should be painted. Cream or ivory is a desirable light color for the wall and ceiling. Grey or buff is a good color for a wainscoting painted four or five feet high around the room. A stenciled design above the wainscoting makes the shop more attractive.

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 the toilet within easy access of the shop. Finishing rooms and metal working areas must have sinks with both hot and cold running water. Place the drinking fountain in or near the shop. Locate a large number of outlets around the room.

Provide gas for furnaces in all metalworking areas.

Heating and Ventilation. Provide heating facilities to maintain room temeprature within the shop. Unit heaters are the best.

Recess all radiators to make more room for equipment. Equip school shops with a ventilating system to carry off all fumes. This is essential for forge, foundry, and welding.

Floors. Concrete floors are probably most economical and practical since all fire-proof buildings are easily constructed with them. An end-grain floor is very satisfactory. Composition floor covering is very desirable if it can be obtained.

Ceiling. The ceiling should not be less than twelve feet; fourteen feet is better. Ceilings much higher in ordinary school shops are a waste of space. Treat ceilings with accoustical 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 steel sash should be provided for all windows.

Exhaust System. Install an exhaust system to remove shavings and dust when the building is being constructed.

Blackboard, Bulletin Board, and Display Case. A blackboard and bulletin board may be placed together in the shop. 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 automechanics 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 locality. 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 in their particular areas. For example: place all sheet metal tools in one area of the panel, the woodwork tools in another area, etc.

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

Assembly Area. Leave an 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.

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. 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.

Fire Extinguishers and First Aid. A fire extinguisher and hose should be installed in a prominent place. Medicine 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 of students to be taught.
7. Funds available.

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 Line" 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.

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

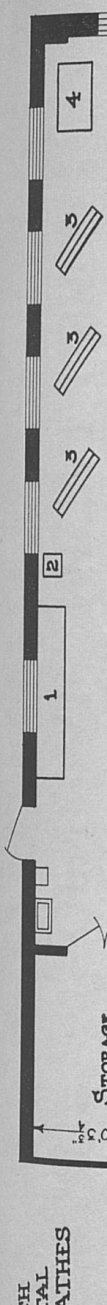
Specifications and Ordering. After decisions have been made to purchase certain tools and machines, specifications must be written. It is important that every particular be given about each tool and machine so that the quality desired may be secured. The specifications must be carefully written for all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

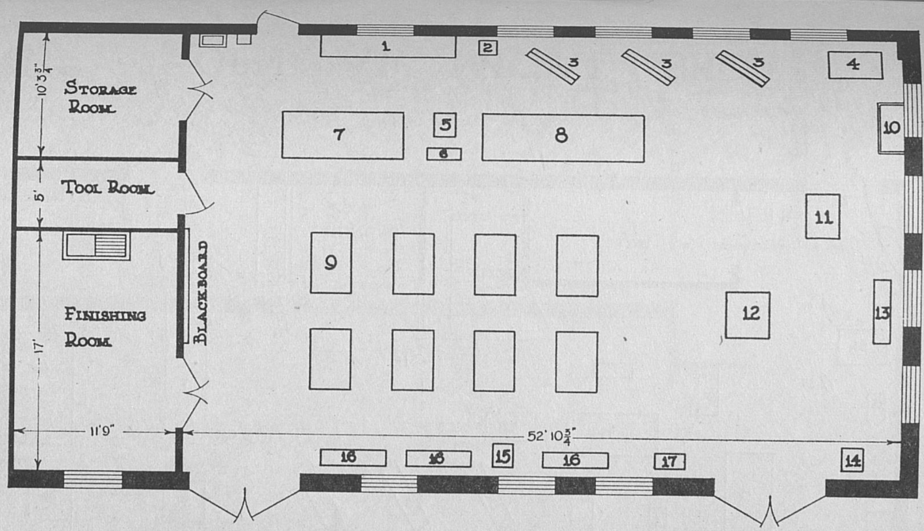
When bids are submitted, check them carefully to see that they conform to the specifications.

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.



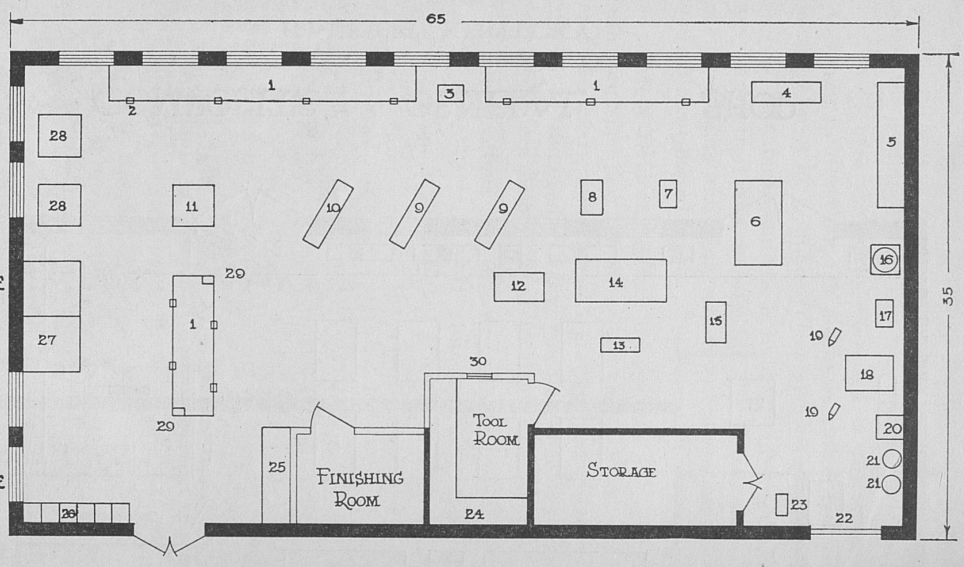
1. METAL BENCH
2. SHAPER-METAL
3. MACHINE LATHES
4. FORGE
5. DRILL PRESS
6. GRINDER
7. STAKES · BAR FOLDER
8. METAL BENCH
9. WOOD BENCHES
10. FOUNDRY
11. TABLE SAW
12. PLANER
13. JOINTER
14. BAND SAW
15. JIG SAW
16. WOOD LATHES
17. MORTISER



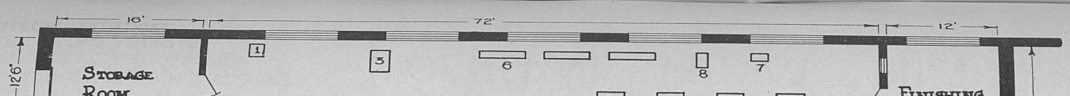
COMPOSITE GENERAL SHOP

FRANKFORT HIGH SCHOOL
FRANKFORT, KENTUCKY

1. METAL WORK BENCH
2. MACHINIST VISE
3. TOOL GRINDER
4. METAL SPINNING LATHE
5. FOUNDRY BENCH
6. PLANNING TABLE
7. DRILL PRESS
8. SMALL SHAPER
9. 11" METAL LATHES
10. 10" METAL LATHES
11. SMALL MILLING MACHINE
12. SQUARING SHEARS
13. BAR FOLDER
14. SHEET METAL BENCH
15. SLIP ROLLER
16. MELTING FURNACE
17. GRINDER
18. FORGE
19. ANVILS
20. HEAT TREATING FURNACE
21. QUENCHING TANKS
22. OVERHEAD DOOR
23. POWER HACK SAW
24. TOOL CABINETS
25. WASH BASINS
26. LOCKERS
27. ELECTRIC WELDING BOOTHS
28. OXY-ACETELENE BOOTHS
29. SOLDERING FURNACE
30. CHECK WINDOW

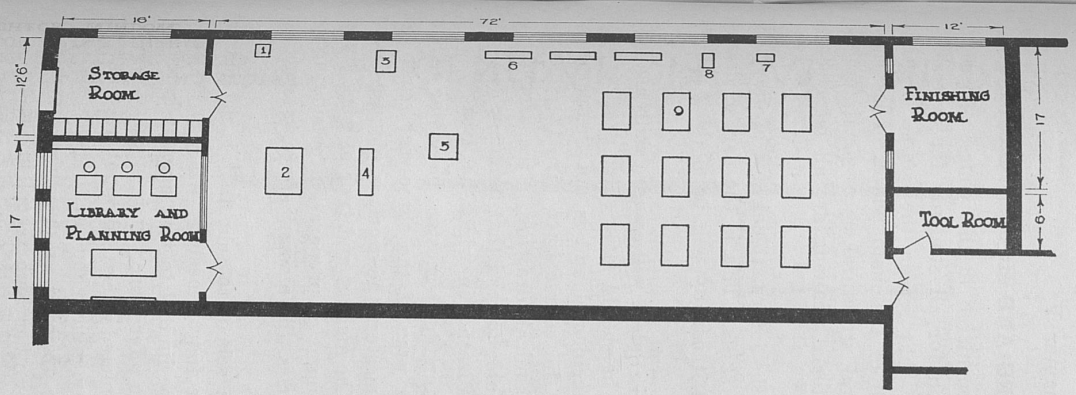


GENERAL METAL SHOP



27. ELECTRIC WELDING BOOTHS
28. OXY-ACETELENE BOOTHS
29. SOLDERING FURNACE
30. CHECK WINDOW

GENERAL METAL SHOP



GENERAL WOOD SHOP

1. MORTISER
2. SURFACER
3. BANDSAW
4. JOINTER
5. TABLE SAW
6. LATHES
7. GRINDER
8. JIG SAW
9. WOOD BENCHES

Chapter V

MECHANICAL DRAWING AND HOUSE PLANNING

Mechanical drawing is considered in this course of study to be a part of general education for all students for general and non-vocational purposes. For that reason the course 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 in the course.

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 course is to give the student a broad familiarity with 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 course 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 course is also outlined for use in junior high schools. Such a course should be offered only in

the eighth or ninth grades and preferably only after some shop-work 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 of 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 course provides for review and more thorough assimilation.

The course 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 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 lists 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 the result of the students' 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 thumbtacks.
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 pencils in drawing 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 of full size, and scale 6″ = 1′ 0″.
30. Check a drawing, using a checklist.
*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 arthmetic, particularly addition and subtraction of common fractions.
8. Review of fundamentals of geometry.
9. Principles of dimensioning.
10. Purpose and construction of each of the projects drawn.
*11. How to take notes on technical reading.
12. Occupation information; opportunities, training, etc.
13. Kinds of pencils used in mechanical drawing.
14. Erasers; methods of cleaning and caring for drawings.
15. How to read a mechanical drawing.

Suggested Problems—For Mechanical Drawing I

Ten plates, size 9½″ x 12″, each requiring approximately nine one-hour periods; 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 a line with the 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″ x 12″, each plate requiring approximately nine one-hour periods. Select one 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, footseel, 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, given 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.
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″ x 19″, each plate requiring approximately eighteen periods. 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 detail; typical shape sections and data table.

PLATE 25. Electrical drawing.

Details, assembly, wiring diagram, and bill of materials for an electric buzzer, bell, 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 Darwing IV

Six plates, size 12″ x 19″, each plate requiring approximately fifteen periods. 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 log 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 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″ x 12″, requiring approximately four hours each.

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 an ability to evaluate types of construction comparatively.
4. To provide a knowledge of the function and professional services of an architect.
5. To provide a knowledge of contracting procedure.
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 use 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" of "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.

Chapter VI

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. 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 involves a greater degree of experience and knowledge in the fundamentals.

The selection of learning units, all or in part, from these groups would be left entirely to the teacher's discretion which, in his opinion, best fit his situation.

Specific Objectives

1. To develop skill in the use of woodworking tools.
2. To provide a knowledge of characteristics and uses of wood.
3. To develop habits of planned and orderly procedures.
4. To 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. To teach the basic principles of wood finishing.
9. Develop attitudes and habits of observing safety precautions.
10. To inspire vocational and avocational interests in woodworking.

Hand Woodworking

OPERATION UNITS—GROUP A

1. Make a working drawing.
2. Make out a bill of material.
3. Measure with a rule.
4. Grind a plane bit.
5. Hone a plane bit.

6. Assemble and adjust a plane.
7. Use a try square.
8. Use a marking gauge.
9. How to use a face mark.
10. Square stock to dimensions.
11. Plane chamfers and bevels.
12. Lay out curves and finish curves.
13. Bore holes in wood.
14. Sharpen an auger bit.
15. Use a brad awl for making holes for screws and nails.
16. How to use wood screws.
17. How to drive nails.
18. How to draw nails.
19. How to set finishing nails.
20. How to use a rip saw, a cross cut saw.
21. How to use a coping saw.
22. How to use a back saw.
23. How to use a miter box.
24. How to use a wood chisel.
25. How to sharpen a wood chisel.
26. How to make a butt joint.
27. How to make a dado joint.
28. How to lay out and make a lap joint.
29. How to make a miter joint.
30. How to make a mortise and tenon joint.
31. How to plane end grain.
32. How to make an edge to edge glue joint.
33. How to make a dowel joint.
34. How to use a doweling jig.
35. How to use bar clamps.
36. How to use hand clamps.
37. How to aply hot glue.
38. How to mix and apply casein glue.
39. How to sharpen and burnish a scraper.
40. How to dress a screw driver.
41. How to set an expansive bit.
42. How to prepare a wood surface for finishing.
43. How to use sand paper.
44. How to use a sanding block.
45. How to apply stains.
46. How to apply shellac.
47. How to apply filler.
48. How to sand between finish coats.
49. How to apply varnish.
50. How to apply paint and enamel.
51. How to rub and polish varnish.
52. How to 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. Cleaning 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. How to use a key hole saw.
53. Cut curves with a turning saw.
64. Fit hinges.
65. Put on locks.
66. Put on drawer pulls.
67. Lay out and make a dove tail 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. How to sharpen a saw.
76. How to use a combination plane.

INFORMATION UNITS

1. Addition and subtraction of fractions.
2. How to 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 screws.
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 wood-working.
13. Composition of abrasives used in woodworking.
14. Economical use of sand paper.
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. To 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. To develop the habit of carefully planned procedure of work.
6. Develop the habit of self-reliance.
7. Offer opporunities 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. To teach finishing by air brush methods.

OPERATION UNITS—GROUP C

Turning Lathe

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.
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 or 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.

Jointer

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.
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

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 dadoes.
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 operation of 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 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 cutterheads 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. Costumer.
15. Picture or mirror frame.
16. Desk or floor lamp.
17. Model airplane.
18. Shoe rack.
19. Smoking stand.
20. Work bench.
21. Tool cabinet
22. Book shelves or cabinet.

Chapter VII

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 in national defense and industrial expansion. Due to the fact that many millions of men and women are employed in the metalworking trades, 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. Sheet Metal

These courses in sheet metal were prepared for the Junior and the Senior High School levels. The units marked with an asterisk may be omitted in a short course where time or equipment would necessitate.

Specific Objectives

1. To explore the ability of the pupil in the use of sheet metal tools and equipment.
2. To establish in the mind of each pupil 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.

OPERATION UNITS

1. Read a working drawing.
2. Make out a bill of material.
3. Plan your procedure.
4. Measure with a rule.
5. Check material when received.
6. Make a dimensioned sketch.
7. Lay out a circle with dividers.
8. Mark pattern on sheet metal.
9. Cut out a pattern using straight and curved shears.
10. Cut out a pattern using squaring shears.
11. Bend the edge of a piece of metal at any angle with a bar folder or hand break.
*12. Form metal in a cornice break.
13. Make a single and double hem by hand and on machine.
14. Form or shape a piece of metal over a stake with a wood mallet or setting down hammer.
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.
20. Wire the edge of a straight piece of metal using the bar folder and wiring machines.
*21. Wire a cone shaped object on the wiring machine.
22. Make a simple parallel line development.
23. Make a simple radial line development.
*24. Shring a piece of metal by crimping in a machine.
25. Reenforce and decorate by beading on machine and by hand.
26. Turn a burr on a circle using the burring machine.
*27. Turn flange on burring machine.
*28. Form a double seam by hand or on machine.
29. Tin a soldering copper.
30. Finish metal by planishing peening, painting, or lacquering.
31. Locate and center punch holes.
*32. Rivet sheet metal by hand and by using the riveting set.
33. Drill a hole through sheet metal and strap iron.
34. Punch holes with solid, hollow, and hand punches.
35. Cut a piece of strap iron with the hack saw.
36. Form a piece of strap iron.
*37. Peen a piece of strap iron.
*38. Cut threads with tap and dies.
*39. Spot weld.
40. File a piece of metal.

INFORMATION UNITS

1. How to plan a job.
2. How to care for all tools and equipment.
3. How to transfer a pattern from a sheet of paper to the metal.
4. The name, correct use of, and adjustments of all hand tools, stakes, and machines used.
5. How to identify the various kinds of sheet metal.
6. Allowances to be made for lapped seams and grooved seams.
7. The kinds of soft soldering and their uses.
8. The kinds of flux and dipping solutions and their uses.
9. How to light and operate a blow torch or furnace.
*10. Resources of iron, tin, zinc, copper, and aluminum.
*11. A brief study of the manufacture of sheet iron, tin plate, galvanized sheet metal, copper, aluminum, and soldering.
12. A brief study of the standard sizes, gauge, and weight of tin plate, galvanized sheet metal, sheet iron, copper, and zinc.

13. A brief study of rivets as to kind and size.
14. How to clean metal surfaces for soldering or finishing.
*15. A brief study of taps and dies.
16. How to decelop a simple pattern by parallel and radial line methods.
*17. Standard guages of wire.
*18. Standard sizes of strap iron.
*19. Kinds of threads and standard sizes of taps and dies.
20. 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.

A Course for Senior High School Level

OPERATION UNITS

1. Copying from a template.
2. Cutting sheet metal with: straight snips, right hand cut, left hand cut, klenks aviation, squaring shears (machine), and bench shears.
*3. Cutting metal with double cutting shears, circle snips, hawk bill, riveter shears, circular cutting shears (machine), and Marshalltown throatless shears (machine).
4. Forming metal by hand and on machines.
5. Breaking metal by hand and by machine.
6. Riveting metal.
7. Hand grooving a piece of metal.
*8. Machine grooving a piece of metal.
9. Double seaming by hand.
*10. Double seaming with machines.
11. Raised bottom seam.
12. Chiseling.
13. Punching a piece of metal, hand punching, machine or tool punching, center punching, and hollow punching.
14. Wiring straight and cone shaped objects by hand and with the wiring machine.
15. Burring and turning metal with the burring machine and by hand.
*16. Elbow edging.
17. O. G. single and triple beading.
18. Crimping a piece of metal to shrink edges.
19. Drilling a piece of metal by hand and machine.
20. Setting down by hand and machine.
21. Sharpening a drill bit.
*22. Sharpening a pair of snips.
23. Grinding.
*24. Gutter beading.
*25. Spot welding.
26. Cutting, straightening, forming, and bending a piece of wire at right angles.
27. Filing.
28. Scraping.
*29. Hard soldering and its uses.
30. Soft soldering—the kinds and uses of each.
31. Soldering galvanized sheet iron, tern plate, coke plate, and charcoal tin.
*32. Soldering zinc, copper, brass, aluminum, monel, stainless steel, and pewter.
33. Assembling and fitting.
34. Polishing and cleaning.
*35. Draw and develop patterns by parallel line method, radial line method, and triangulation.
36. Read blue prints for sheet metal.
*37. Make the following: Pittsburgh seam, Boston seam, drive slides, and "S" slides.
*38. Construction of square ducts.
*39. Construction of ventilators.
*40. Construction from square to round.

*41. Installation of control dampers.
*42. Local heating code.
*43. Standard sheet metal code.
*44. Aviation techniques and care in laying out, forming, and riveting of aluminum sheets.
*45. Use of the air riveter.
*46. Use of air hammer.
*47. Use of aluminum rivets (aviation types).
*48. Etching of copper and brass.
*49. Raising of copper and brass.
*50. Coloring of copper and brass.
*51. Hand hammering of metal.
*52. Chasing metal.
*53. Metal spinning.
54. Specific use of the following: Jeweler saw, taps and dies, matting tools, and chasing tools.

INFORMATION UNITS

1. The name, use, and adjustments of all hand tools. stakes, and machines used.
2. Care of all hand tools, stakes, and machines used.
3. Allowance for single hem, double hem, groove seam, wire edge, and burrowing.
*4. Allowance for raised bottom, Pittsburgh seam, elbow edge, "S" slide, and drive slide.
5. Reading the circumference rule.
6. Recognition of the following materials and their general characteristics and uses; tern plate, coke plate, charcoal tin, soft and planished copper, lead, stainless steel, brass, black iron, soft solder, rosin, muriatic acid, zinc chloride, sal ammoniac, and aluminum.
*7. Recognition of the following materials, their general characteristics and uses; zinc, tin, monel, hard soldering, Russian iron, hot rolled pickled and annealed sheet steel, cold rolled sheet steel, patented fluxes—both liquid and paste.
8. Thickness, specification, and commercial sizes of the following: galvanized iron, sheet copper, tin plate and tern plate.
*9. Thickness, specifications, and commercial sizes of the following: brass, monel, stainless steel, and zinc.
10. Sizes and shapes of soldering coppers.
11. Relative values of electric soldering coppers.
12. Types of soldering pots—gas, gasoline, and charcoal.
13. How to clean solder and copper.
14. How to determine when the soldering iron is hot.
15. Approximate cost of materials.
16. Safety rules.
*17. Sheet metal screws.
*18. Usual commercial sizes for various kinds of stock.
19. Probable future for sheet metal industries.

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.

B. Foundry and Heat-Treating

Specific Objectives

1. To stimulate the acquisition of a 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 acquaint the pupils with the methods of cleaning and finishing castings.

7. To develop an appreciation of the importance of good design and the appropriate use of metals.

8. To furnish a background for pupils desiring to enter the engineering profession.

FOUNDRY OPERATION UNITS

1. How to construct a simple pattern.
2. Select proper shrinkage rule suitable for type of metal to be cast.
3. How to make a split pattern.
4. How to make a built-up pattern.
5. How to build a pattern by the segment process.
6. How to make core prints.
7. How to prepare sand for molding.
8. How to cut sand.
9. How to test sand for proper moisture.
10. How to riddle sand.
11. How to select flask and arrange patterns.
12. How to ram a mold.
13. How to use parting and facing materials.
14. How to vent mold.
15. How to remove pattern.
16. How to use slick, spoon, etc.
17. How to patch broken mold.
18. How to cut spruce gate.
19. How to form an irregular joint in a mold.
20. How to make a sand core.
21. How to prepare and pour metal.
22. How to remove gates and clean castings.
23. How to set a core in a mold.
24. How to judge the heat of metal by color.
25. How to make a pattern from a commercial job.
26. How to use bellows.
27. How to draw pattern out of sand.
28. How to use auxiliary holding devices, such as crossbars, gagers, solders, nails, etc.
29. How to cut skimming gates.
30. How to pour small castings using hand ladles.
31. How to light smelting furnace.
32. How to pickle castings.
33. How to pour metal in ladles from cupola or furnace.
34. How to build proper equipment for handling molten metal.
35. How to skim molten metal.
36. How to handle molten metal.
37. How to keep a steady stream of metal flowing into the mold.
38. How to dispose of left-over metal.
39. How to pour light and heavy work.
40. How to mix a charge.
41. How to weight out a charge.
42. How to clamp mold.

43. How to identify molding, fire, and free sands.
44. To be able to identify and select the binders used in specific core sand mixture.
45. How to clean and care for crucibles.
46. How to mix fire clay, linings, and daubing.
47. How to select and set rods in cores.
48. How to alter flask and adjust pins.
49. How to build flasks and molding boards.
50. How to select gagers, soldiers, and nails for retaining sand.
51. How to use shovel in handling sand and other materials.
52. How to use core plates in making cores.
53. How to place patterns on a molding board.
54. How to swab, rap, and draw patterns.
55. How to use rent rods and risers in renting a mold.
56. How to pre-heat crucibles.
57. How to select and set sprues.
58. How to test for pouring temperature.
59. How to form tap hole.
60. How to put on the blast.
61. How to clean away refuse from previous heat.

FOUNDRY INFORMATION UNITS

1. Types of materials used in pattern making.
2. Classifications of castings as to strength, toughness, durability.
3. Types of molding: Greensand work, core ware, drysand work, foam work.
4. Types of materials used in foundry for making molds.
5. How to select proper sand for class of work to be done.
6. Types of flasks.
7. Manufacture of iron and steel.
8. Copper—(1) source (2) uses.
9. Brass—(1) source (2) uses.
10. Lead—(1) source (2) uses (3) alloys.
11. Aluminum—(1) source (2) uses (3) alloys.
12. Type of metals and their melting points.
13. Type of patterns.
14. Methods of finishing.
15. Terminology used in foundry.
16. Types and kinds of facing materials.
17. Molding tools and equipment.
18. Cores and binders.
19. How to construct patterns with removable parts.
20. Cupola and melting practices.
21. Methods of cleaning castings.
22. Shop safety.
23. Identification of metals.
24. Identification of molding, fire, and free sands.
25. Identification of clay and lining mixture.
26. Types of core binders.
27. Fuels used to light core ovens and furnaces.
28. Chaplets and their use.
29. Where metals used in foundry are obtained and prepared for use.
30. Characteristics of metals used in foundry.
31. Melting points of metals.
32. Source of sand materials.
33. Kinds of sands used in foundry.
34. Compositions of sands.
35. The care and preparations of sands.
36. The manufacture and mining of facing materials.
37. Kinds of facing materials.
38. Purpose of blackenings and how accomplished.

Suggested Projects

1. Woodworking vise.
2. Small drill press.
3. Small lathe (woodturning).
4. Book ends.
5. Door stops.
6. Door knockers.
7. Gear blanks.
8. Small anvil.

9. Jack.
10. Bending jigs.
11. Motor base.
12. Drill press vise.
13. Small circular saw.
14. 6 inch jointer.
15. Lathe rests.
16. Face plate.
17. Lamp base.
18. Small punch press.
19. Small disc sander.
20. Andirons.
21. Name plate.
22. Candle stick and holders.
23. Paper weights.
24. Lamps.
25. Plaques.

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. Drill on drill press.
12. Cut threads using screw-plate set.
13. Rivet.
14. Saw with hack saw.
15. File.
16. Cleaning of fire place.
17. Make coke from green coal.
18. Decrease thickness, width, or both and increase length.
19. Point stock.
20. Flare stock.
21. Twisting metal.
22. Cut off stock.
23. Use cold cutter.
24. Use hot cutter.
25. Use hardie cutter.
26. Grinding and care of above tools.
27. Use forge vise.
28. Use of edge of anvil.
29. Use of jigs.
30. Use of scroll horn and wrench.
31. Prevent fractures.
32. Prepare stock for hardening.
33. Heating stock for hardening.
34. Annealing stock.
35. Use of one heat for hardening and tempering.
36. Use of heated block for tempering.
37. Case hardening.
38. Pack hardening.
39. Use of fluxes.
40. Cautions to observe.
41. Layout and measure given pattern.
42. Use square, calipers, center punch, scratch awl, and trammel points.
43. Use lever shear.
44. To estimate a bill of material.
45. To read blueprints.
46. To design wrought iron articles for home use.
47. To properly forge a cold chisel and punch.
48. To harden and temper a cold chisel and punch.
49. To test cold chisel and punch for toughness.
50. Either of 48 and 49 to be heat-treated in gas forge or electric furnace.

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 functions of their various parts.

11. The anvil, the use of its various parts.
12. Names and uses of blacksmith tools.
13. The standard screw plate sets.
14. Kinds of files and their uses.
15. Effect of heat on steel.
16. The principles of welding.
17. How fluxes act.
18. Annealing of ferrous and non-ferrous metals.
19. Expansion of iron and steel.
20. Spark test for determining kinds of metals.
21. Type of fire used in forge.
22. Forging temperature of metals.
23. Hardening of metals.
24. Tempering of metals.
25. Critical temperature of metals.
26. Proper heat-treatment of metals.
27. The importance of safety precautions.
28. The proper handling of tools and materials.
29. Danger from fumes and gases.
30. Metallurgy of metals.
31. Expansion and contraction of metals.
32. Methods of producing pressure.
33. Shop problems involving fundamentals of arithmetic, fractional measurements.
34. How to estimate a bill of material.
35. Correct pronunciation and spelling of tools, materials, operations, and processes.
36. Testing of metals (heat-treating).
37. Chemical metallurgy (heat-treating).
38. Physical metallurgy (heat-treating).
39. Engineering heat-treatments.
40. Heat-treatments of non-ferrous alloys.
41. Calculating time required to heat tool steel (heat-treating).
42. Types of heat-treating furnaces and equipment.
43. Location of hardening room.
44. Types of quenching equipment.
45. Types of liquid baths.
46. Effect of improper heating on metals.
47. Oxidizing and reducing atmosphere.
48. Tempering colors and degrees of each.
49. Oxidizing fire.

Suggested Projects

1. Andirons.
2. Aquarium.
3. Curtain brackets.
4. Tire tool set.
5. Hammer heads.
6. Hooks.
7. Pinch bars.
8. Knives.
9. Floor lamps.
10. Cold chisel.
11. Pin punches and solid punches.
12. Scratch awls.
13. Wall brackets.
14. Table lamps.
15. Center punch.

Exercise Work

1. Draw and upset 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.

C. 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 provide 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 teach principles of physics and metallurgy underlying the welding of metals.
6. To acquaint the pupils with various kinds of metal and the means of identifying them.
7. To stimulate a study of methods employed in testing welds.
8. To develop an ability to calculate the expansion and contraction resulting from a welding operation.
9. To acquire a knowledge of materials and methods used in the manufacture of acetylene gas.

ARC WELDING OPERATION UNITS

1. To strike an arc and run flat beads (bare electrode).
2. To run continuous beads (bare electrode).
3. To be able to weave and oscilate (bare electrodes).
4. To build up a pad (bare electrode).
5. To be able to use different size electrodes (bare).
6. To be able to construct Tee or fillet welds (bare electrode).
7. To be able to make a butt weld with bare electrode.
8. To be able to do vertical and overhead welding (bare electrode).
9. To run continuous flat beads using shielded arc.
10. To weave using shielded arc electrode.
11. Padding with shielded arc electrode.
12. To be a lap weld in flat position using shielded arc electrodes.
13. To do Tee or fillet welds in flat position using shielded arc electrode.
14. To do horizontal welding using shield arc electrode.
15. To be able to spot using shielded arc electrode.
16. Horizontal welding of lap and butt joints using shielded arc electrode.
17. Vertical lap and fillet welds, welding down using shielded arc electrode.
18. Vertical butt joints, welding down using shielded arc electrode.
19. Vertical welding beads only, welding up.
20. Vertical welding butt joints, welding up.
21. Overhead welding, running beads only using shielded arc electrode.
22. Overhead welding, lap and fillet welds with shielded arc electrode.
23. Overhead butt welds with shielded arc electrode.

24. To be able to do cutting using the electric arc (carbon and shielded).
25. To be able to weld using different types of shielded arc electrode.
26. To be able to weld with bronze electrode (shielded arc).
27. To be able to do hard surfacing.
28. To be able to grip the electrode properly.
29. Weld a butt pipe weld using shielded arc.
30. To test welds properly.
31. To set machine for proper polarity.
32. To be able to 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. Cutting electrodes.
8. Knowledge of reverse and straight polarity.
9. Principles of the arc welder.
10. Methods of striking an arc.
11. Common methods used in welding various joint construction.
12. Different sizes of electrodes.
13. Polarity and arc blow.
14. Expansion and contraction.
15. Cutting with electric arc.
16. The principles of arc weld surfacing.
17. Welding accessories essential.
18. Jig construction.
19. Principles of physics and metallurgy in making a weld.
20. Identifying of different metals.
21. Weaving or movement of electrodes.
22. Effect of arc length, amps, and speed on bead.
23. Effect of polarity on bead.
24. Padding, building up plates.
25. Butt welds.
26. Lap welds.
27. Tee welds.
28. Vertical welds.
29. Horizontal welds.
30. Horizontal joints, laps, etc.
31. Fillet welds.
32. Penetration.
33. Speed of welding.
34. Strength of welds.
35. Preparation of work.
36. Normalizing.
37. Factors influencing the stability of the arc.
38. Preheating and annealing.
39. Requnirement of efficent cables.
40. Functions of an electrode holder.
41. Knowledge of what governs the depth of the arc-crater.
42. Care of materials to be welded before the arc is applied.
43. Knowledge of coated electrodes.
44. Materials used for electrodes.
45. Types of eye shields.
46. Function of rheostate, voltmeter.

OXY-ACETYLENE WELDING OPERATION UNITS

1. Connect oxygen supply to the blowpipe.
2. Connect acetylene supply to the blowpipe.
3. Operate welding blowpipe.
4. Be able to adjust neutral, excess acetylene and excess oxygen flames.
5. Operate the cutting blowpipe.
6. Be able to apply general operating rules.
7. Be able to melt various metals to learn their characteristics.
8. Carry welding puddle on steel in all positions without rod.
9. Prepare steel plate for single "vee" joint, double "vee", etc.
10. Test weld for penetration.
11. Weld typical joints on sheet metal.

12. Construct simple frame and weld.
13. Bronze weld cast iron.
14. Be able to identify metals by spark test.
15. Handle welding outfit safely.
16. Care and setting of apparatus.
17. To run continuous beads on flat work using light gauge metal (no oscillation).
18. Recognize appearance of molten metal.
19. Recognize action of molten metal under flame.
20. Make butt welds in different gauge metals.
21. Bevel steel plate, cut holes in steel plate and cut off rivet heads.
22. Make up different small useful objects out of sheet steel to get practice in settings and tack weldings.
23. Weld joints in simple structural steel frames.
24. Heat and bend metal into various angles.
25. Make up a simple rectangular frame out of angle iron.
26. Bronze-surface steel and cast iron parts.
27. Keep equipment in good operating condition.
28. Change valve seat in a regulator.
29. Make up a hose connection or a splice; using scrap piece of hose.
30. Be able to cut cast iron.
31. Weld cast iron with cast rod.
32. Pre-heat cast iron for welding.
33. Be able to care for expansion and contraction in welding.
34. Lap weld flat, vertical, and overhead.
35. Make a "Tee" weld flat, vertical, and overhead.
36. Make a butt, "Tee", angular and fillet weld (pipe welds).
37. Make a flange weld.
38. Form rivet head.
39. Make a butt weld open single "vee".
40. Make tubular butt weld.
41. Make a vertical fillet weld.
42. Make a combination plate and tube fillet weld.
43. Weld aluminum, cast and rolled.
44. Weld stainless steels.

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 blowpipes.
6. Construction and operations of regulators.
7. Welding and cutting accessories.
8. Preparation for welding.
9. The oxy-acetylene flame.
10. Characteristics of oxygen and acetylene.
11. Principles of oxy-acetylene cutting.
12. Metallurgy of steel welding.
13. Setting-up apparatus.
14. Scope of the oxy-acetylene process.
15. Welding of different metals.
16. Know what a fusion weld is.
17. Combustion—the oxy-acetylene flame.
18. Explosive gas mixtures—backfires and flashbacks.
19. Nature of iron and steel.
20. Welding of non-ferrous metals.
21. Other uses of the oxy-acetylene flame.

Suggested Projects

1. Stools.
2. Brackets.
3. Garden tools.
4. Tool rests.
5. Crates.
6. Fire-place sets.
7. Andirons.
8. Music stands.
9. Tool cabinets.
10. Potato diggers.
11. Wrenches.
12. Door stops.

13. Trailer frames.
14. Toys.
15. Hangers.
16. Map stands.
17. Lamps.
18. Candle holders.
19. Ash trays.
20. Magazine racks.
21. Radio table.
22. Welding table.
23. Blue print washer.
24. Welding rod rack.

Chapter VIII

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 overemphasized. The opportunities it affords for the development of skills in dimensioning and shaping metals 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 tools and their uses.
2. Develop skills in the use of hand tools, precision measuring instruments, the drill press, engine lathe, milling machine, plane and shaper.
3. Develop the proper attitude toward accuracy.
4. Train the student to become proficient in simple tool design.
5. Develop an appreciation for good tools, machines, and other equipment.

Machine Shop I—One Semester

OPERATION UNITS

1. Grind four kinds of turning and threading tools.
2. Center round stock by at least three methods.
3. Measure within 1/64" with rule and calipers.
4. Turn diameters to 1/64" tolerance.
5. Set up and cut 60° V threads in the engine lathe.
6. Turn tapers by hand and by tail stock set over.
7. Center work in an independent chuck.
8. Harden and temper, by color, carbon tool steel.
9. Grind a twist drill.
10. Set up work for accurate drilling in the drill press.
11. Set up milling machine for slab or surface milling.
12. Do simple indexing on the milling machine.
13. Finish metal with files and emery cloth.
14. Properly lubricate machine tools.

INFORMATION UNITS

1. How to read a rule with No. 4 graduation.
2. How to read a working drawing.
3. Chief characteristics of cold rolled steel, tool steel, cast iron, and bronze.
4. How to draw working sketches for shop use.
5. How to use reference books and charts.
6. Proper speeds for turning, drilling and milling cold rolled steel, tool steel, cast iron, and bronze.
7. Proper coolants for turning, drilling, milling and tapping.
8. How to read a micrometer.

Machine Shop II—One Semester

OPERATION UNITS

1. Cut internal threads in the engine lathe.
2. Use steady and follower rests.
3. Turn tapers with taper attachment.
4. Set up milling machine for cutting spur gear.
5. Index and cut a spur gear.
6. Grind four right and left hand shaper tools.
7. Set up shaper for vertical and horizontal cutting.
8. Set up a job on planer.
9. Grind planer tools.
10. Anneal carbon tool steel.
11. Grind lathe centers with the tool post grinder.
12. Turn square and acme threads.

INFORMATION UNITS

1. How to use formulas for turning tapers.
2. Drill sizes for common taps.
3. How to use the vernier.
4. How to use a diel test indicator in the lathe.
5. How to use a dial test indicator on the planer and shaper.
6. Characteristics of high speed steel.
7. How to use a surface gauge.
8. How to spot finish metal with a drill press.
9. How to make angular cuts on the shaper.

Suggested Projects

1. Outside firm joint calipers.
2. Vise screw.
3. Center punch.
4. Scriber.
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 guage.
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 jack.
27. Pair of 6" hold downs.
28. Drill point gage.
29. Center wiggler with No. 2 morse taper.
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.
36. Machinists steel rule clamp.

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

Chapter IX

ELECTRIC SHOP

This course in electricity has been prepared for use in high schools which offer two semesters of electric work.

It is suggested that all teachers concerned require each student to keep an accurate notebook for recording the Information Units. In addition each student should keep an accurate record of his Operation Units in his note book or the teachers should prepare job sheets for the pupil's use. If preferable, a good job manual may be obtained at small cost. Thus, when the student moves to a different community the shop teacher can definitely see what has been covered by the student and thereby insure continuity of his program.

To be practical, students should be encouraged in the phase of electrical work in which they are most interested. If a student is most interested in radio let him construct a radio and omit the house wiring unit. Of course he will be required to meet the minimum essentials on such elementary jobs as use of tools, shop procedure, bell wiring, etc. These requirements may be met through careful planning of the instruction program and a close supervision of the student's work regardless of the particular phase of electricity he elects, whether it be radio, motor work, transformer work, or light wiring. It is not expected that the student will learn all the things in the lists below. The teacher should select from the lists, and add to his selection, those units which he regards as most important, and for which adequate facilities are available.

Specific Objectives

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

OPERATION UNITS

1. Make a chronological table of electrical inventions and discoveries.
2. Be able to give a demonstration of static electricity and explain what happens.
3. Make an electro-magnet.
4. Make a number of different splices including Western Union, two wire pigtail, three wire pigtail, tap on branch splice, lamp cord splice on some specific job or device.
5. Make an extension cord.
6. Put an appliance plug on an iron cord.
7. Wire a pair of three-way switches.
8. Use voltmeter and ammeter to measure pressure, current and resistance.
9. Construct a slidewire and whetstone bridge to find values of unknown resistors.
10. Construct a toy motor.
11. Construct a demonstration generator.
12. Dismantle and assemble motors.
13. Read meters (K.W.H.) and compute bills.
14. Wire an electro-pleating job.
15. Do a wiring job with metallic cable.
16. Do a job with knobs and tubes.
17. Do a job with non-metallic cable.
18. Dismantle and reassemble a demonstration board wired with thin-wall conduit.
19. Dismantle and reassemble a demonstration unit wired with rigid conduit.
20. Do bell wiring jobs.
21. Construct an electric toaster or heater.
22. Make a crystal set.
23. Make a one-tube radio.
24. Make a two-tube radio.
25. Make a telegraph set.
26. Make a bell transformer.
27. Test tubes.
28. Make a load test and H.P. test on a motor generator set.
29. Charge a storage battery.
30. Make a small public address system.
31. Make a burglar alarm system.
32. Hook-up different annunciator systems.
33. Make a simple galvanometer.
34. Make an electric pencil.
35. Wind an armature.
36. Make a thermo-couple.
37. Make a relay.
38. Make a simple battery.
39. Make a test light.
40. Make a phone-oscillator.
41. Make a code practice oscillator.
42. Wire a rural line telephone (simple).
43. Wire an inter-office telephone.
44. Wire a D.C. and A.C. watt-hour meter.
45. Wire two-three way and one-four way switches.
46. Re-magnetize a permanent magnet.
47. Make a buzzer.
48. Make a radio power supply.
49. Test condensers.
50. Make repairs on home electrical appliances, such as electric irons, toasters, fans, motors, curling irons, lamps, radios, etc.

INFORMATION UNITS

1. A brief history of major discoveries and inventions in electricity.
2. Electron theory, electric current.
   a. Use of electron theory.
   b. Electrical charges.
   c. Laws of electrical charges.
   d. Matter and molecules.
   e. Compounds, elements, atoms.
   f. Atomic structure.
   g. Chemical action.
   h. Charged bodies.
   i. Electromotive force.
   j. Sources of E. M. F.
   k. Velocity of propogation.
   l. Direction of electrons and current.
   m. Electric conductors.
   n. Electric insulators.
   o. Dilectric strength.

3. Ohm's law, electrical units.
   a. Coulomb (quantity of current).
   b. Ampere (rate of current).
   c. Milliampere, micro-ampere.
   d. Volt (E.M.F.), Kilovolt, and millivolt.
   e. Resistance (Ohm).
   f. Microhm, megohn, conductance, the mho.
   g. Absolute and international units.
   h. Ohm's law, volt drop, fall of potential, etc.
   i. Electrical power.
   j. Length, area, material and resistance.
   k. Wire gauges.
   l. Circular measure.
   m. Temperature and resistance.
   n. Watt's dissipation (Watt's Law).
4. Electric Measurments.
   a. Series circuits.
   b. Parallel circuits.
   c. Series-parallel circuits.
   d. Combination of resistance.
   e. Use of voltmeter and ammeter, wattmeter.
5. Batteries.
   a. Cells and batteries.
   b. The ion.
   c. Wet primary cell.
   d. Dry cell.
   e. Connecting dry cells.
   f. Lead acid storage cell.
   g. Testing and care of storage batteries.
   h. Edison nickel-iron-alkaline battery.
6. Magnetism.
   a. Natural magnets.
   b. Artificial magnets.
   c. Laws of attraction and repulsion.
   d. Classification of substances.
   e. Magnetic lines of force.
   f. Permanent and temporary magnets.
   g. Theory of magnets (molecular).
   h. Permanent magnet steels.
7. Electro-Magnetism.
   a. Use of electro-magnets.
   b. Magnetic field about a straight wire carrying current.
   c. Magnet field about a coil.
   d. Poles of a solenoid.
   e. Cause of field about a wire.
   f. Electron theory of magnetism.
   g. Kinds of electro-magnets.
   h. Magnetizing permanent magnets.
   i. Magnetic calculations.
   j. Hysteresis losses.
   k. Ampere turns.
8. Electro-Magnetic Induction.
   a. Generating E.M.F.
   b. Value of induced E.M.F.
   c. Lenz's law.
   d. Alternating current generator.
   e. Direct current generator.
   f. Mutual induced current.
   g. The transformer.
   h. Transformer windings.
   i. General transformer construction and application.
   j. Leakage flux.
   k. Self induction.
   l. As applied to radio coils and propagation of radio signals.
9. Motors, D. C.
   a. Series.
   b. Shunt.
   c. Inter-poles.
   d. Control.
   e. Applications.
   f. Horse-power output.
10. Motors A. C.
   a. Series.
   b. Split-phase.
   c. Repulsion-induction.
   d. Three-phase.
   e. Control.
   f. Application.
11. Radio, Elementary Theory.
   a. Crystal set.
   b. One tube auto-dyne.
   c. Audio amplifiers.
   d. Rectifiers.
   e. Elementary testing and wiring.
12. Lighting.
   a. Home.
   b. Industrial.
   c. Photo-cell.
   d. Fluorescent.
   e. Application.
13. Telephones.
   a. Elementary theory.
   b. Wiring and testing.

14. Telegraph.
    a. Elementary theory.
    b. Wiring and testing.
15. Radio and electrical symbols (as used in house and radio wiring).
    a. Radio equipment.
    b. Housce wiring equipment.
16. Underwriters Code (A, B).
17. Condenser (capacitance).
    a. Construction
    b. Application.
    c. Fixed.
    d. Variable.
    e. Theory.
18. Elementary A.C. Circuits.
    a. Difference between A.C. and D.C.
    b. Effect of inductance.
    c. Transmission of A.C.
    d. Effect of capacitance.
    e. Effect of resistance.
    f. Effect of combinations of the above three in series parallel, etc.
19. Elementary Theory Radio Transmission.
20. Elementary Theory Radio Reception.

Chapter X

AUTOMOTIVE SHOP

Specific Objectives

1. To give the pupils a fundamental understanding of power development.
2. To indicate the relationship between the theoretical and the practical aspects of motors.
3. To develop basic skills in use of automotive equipment.
4. To review fundamental mechanical principles.

OPERATION UNITS

First Semester

1. Identify the individual motor parts.
2. Identify the hand tools used in shop.
3. Use a socket set.
4. Use an open end wrench.
5. Use a box wrench.
6. Disassemble an L head motor.
7. Identify and state the function of each motor part.
8. "Time" the camshaft with the crankshaft.
9. Adjust the tappets.
10. Fit the connecting rods to the crankshaft.
11. Adjust main bearings.
12. Adjust spark plugs.
13. Remove and replace tires; drop center rims; lock rim wheel; safety wheel.
14. Patch inner tube, cold patch.
15. Patch inner tube, hot patch.
16. Inspect casings.
17. Remove and replace spring shackels.
18. Ajust shackles.
19. Rebuild springs.
20. Remove and replace "I" beam axle.
21. Remove and replace tubular axle.
22. Remove and replace knee action "Chevrolet type".
23. Remove, replace and adjust front wheel.
24. Remove, replace and refill shocks.
25. Remove and replace rear wheels.
26. Remove and replace rear axle bearings.
27. Remove and replace transmission, several types.
28. Overhaul transmission.
29. Remove and replace clutch.
30. Adjust clutch.
31. Put battery on charge.
32. Test battery.
33. Remove dents from fenders and body.
34. Wash and wax car.
35. Change oil and lubricate chassis.

INFORMATION UNITS

1. Elementary knowledge of the operating principles of internal combustion engines.
2. Names and functions of engine parts.
3. Procedure for disassembling motor.

4. Basic principles of engine design.
5. The four-stroke-cycle motor.
6. The need for lubrication.
7. Procedure for rebuilding a motor.
8. Main classification of cooling systems.
9. Operation of manual and hydraulic jacks.
10. Manipulation of hand tools, gauges, and air hose.
11. Characteristics of each type of patch.
12. Procedure for rebuilding springs.
13. Function of spring shackles.
14. Types of bearings used.
15. Necessity for different types of axles.
16. Types of transmission.
17. Principles underlying different types of transmission.
18. Knowledge of free-wheeling mechanism.
19. Working principles of different types of clutch.
20. Chemistry of storage battery.
21. Polarity and charging rate.
22. Shedding and sulfating.
23. How to clean and wax a car.
24. Care of interior of car.
25. Things that damage car finishes.
26. State and National laws concerning the operation of autos.
27. Local ordinances affecting drivers.
28. Safe methods of operation.
29. Road markers and lights.
30. How to read a road map.

OPERATION UNITS

Second Semester

1. Use cylinder micrometer.
2. Determine the size of wrist pins, crankshaft, camshaft, with micrometer calipers.
3. Disassemble the piston from the connecting rod.
4. Determine type of bearing.
5. Determine type of lubricating system.
6. Disassemble oil pump.
7. Test oil pump.
8. Trace flow of oil from pump to all parts of car.
9. Trace path of cooling system.
10. Disassemble carburetor.
11. Test induction coil.
12. Trace ignition circuit.
13. Adjust breaker points.
14. Test condenser.
15. Disassemble starter motor.
16. Trace current in starting motor.
17. Test starting motor.
18. Disassemble generator.
19. Assemble generator and check output.
20. Remove and replace coil springs front and rear.
21. Check caster and camber.
22. Toe-in and toe-out.
23. King pin inclination.
24. Install shimmy wedges.
25. Rebush front end (steering).
26. Remove and replace L.S. arm knee action.
27. Remove and replace axle, rear, semi-floating type.
28. Remove and replace rear axle ¾ floating.
29. Remove and replace rear axle full-floating type.
30. Overhaul differential, ring gear-pinion, gear-spider gears, and bearings-pinion bearing.
31. Adjust differential.
32. Reline several types of brakes.
33. Adjust mechanical and hydraulic brakes.

INFORMATION UNITS

1. The physics of a motor—gas pressure, torque, displacement, compression ratio, etc.
2. The two-stroke-cycle motor.
3. Valve grinding procedure.
4. Types of lubricating systems.
5. Purpose and use of oil pumps.
6. The need for a cooling system.

7. The maintenance of an efficient cooling system.
8. Types of fuel systems.
9. Octane rating of gasoline.
10. Different types of axles.
11. Operation of fuel pumps.
12. Principles of carburetion.
13. Methods of checking fuel systems.
14. Purpose and operation of ignition systems.
15. Induction coils.
16. Methods of timing ignition.
17. Purpose and types of spark plugs.
18. Repair and operation of starting motor.
19. Steering geometry.
20. Types of steering gears.
21. Steering adjustments.
22. Theory and physics of steering.
23. Theory and principles of knee action.
24. Types of knee action.
25. Servicing of knee action.
26. The meaning of gear ratio and the effect on power and speed.
27. Mechanics of differential.
28. Proper lubrication for differentials.
29. Adjustments of differential.
30. Proper lubrication of transmission.
31. Types and principles of different models of brakes.
32. Methods of adjusting all types of brakes.
33. Fundamental principles of hydraulics.

OPERATION UNITS

Advanced Course

1. Compute the displacement of motor.
2. Determine accuracy of crank pin and main journal.
3. Check accuracy of thermostat.
4. Trace path of air and gasoline.
5. Clean air filter.
6. Calculate S. A. E. horsepower of motor.
7. Calculate horsepower of motor at a given R. P. M.
8. Assemble starting motor and check operation.
9. Trace electric current from generator to battery.
10. Trace current in voltage and current regulator.
11. Overhaul several types of universal joints.
12. Complete check of wiring system of several types of car.
13. Replace seal beam light bulb.
14. Adjust head lights.
15. Overhaul generator.
16. Adjust charging rate of generator.
17. Adjust starter, install new brushes.
18. Overhaul bendix drive.
19. Overhaul positive shift start.
20. Check starter bushings.
21. Check and repair radiator.
22. Remove and replace water pump.
23. Repack water pump.
24. Rebuild a leak-proof water pump.
25. Repaint and trim a car.
26. Make acetylene weld of fender or body.
27. Make an arc weld on axle or chassis.

INFORMATION UNITS

1. Valve timing diagrams.
2. Classification of liquid cooled motors.
3. Duties and importance of motor oil.
4. Various tests of motor oil.
5. Methods of filtering and cooling oils in motors.
6. Methods of lubricating main and connecting rod bearings.
7. Construction of types of bearings to suit specific lubricating systems.
8. Types of oil control piston rings.
9. Kinds of anti-freeze.
10. Petroleum products.
11. Calculation of brake horsepower.

12. Calculation of S.A.E. horsepower.
13. Function of generators.
14. Operation of current and voltage regulator.
15. Blueprint reading of generators, motors, and wiring systems.
16. Principles and need for universal joint.
17. Adjustment of certain types of transmission.
18. Location of fuses.
19. Understanding the headlight adjustment chart.
20. Understanding of the starting system.
21. Principles of electricity and magnetism.
22. How to prepare material for soldering.
23. How to tin a soldering copper.
24. Principle of the water pump.
25. Symptoms and correction of a faculty water pump.
26. Knowledge of the chemical composition of paints and lacquers.
27. Preparation of car for finish.
28. How to prepare finishing material.
29. How to operate an air gun.
30. Methods of striping.
31. Materials for welding.
32. How to prevent corrosion of battery connections.
33. Results of "riding the clutch".

Chapter XI

PRINTING

Specific Objectives

1. To develop a knowledge of the method and 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 proofpress.
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. Clean a case.
22. Lubricate a job press.
23. Ink a job press.
24. Prepare a tympan.
25. Set gauge pins.
26. Make ready.
27. Feed a job press.
28. Prevent offset.
29. Wash up a job press.
30. Care for an ink slab.
31. Count paper.
32. Jog stock.
33. Pad paper stock.
34. Hand folding.
35. Wrap a package neatly.
36. Lock up form for press.
37. Setting a tabular form using leaders.
38. Setting a tabular form using rule.
39. Make up a six-page folder.
40. Use of initial letters.
41. Set a display job; newspaper advertisement, placard, or hand bill.
42. Set form for two-color job.
43. Lock up forms for two-color job.
44. Mixing printing inks.
45. 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. Printers' 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. How perforating and punching is done.
32. Opportunities and requirements of the printing trades.
33. Differentiation between folders and booklets; posters and placards.
34. Care of motors.
35. Importance of cleanliness in handling paper.

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, thence, 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. Set a business letter.
12. Lay out and set an announcement—professional or business.
13. Set a menu for a luncheon or dinner.
14. Plan and set a one-page program for school assembly.
15. Plan and set a ticket for school play or game.
16. Design and set a title page for booklet.
17. Design layout and set a placard announcing school play.
    A. For one color.
    B. For two colors.
18. Set a rule form with two or more columns to run "work and turn".
19. Set a panel using initial letter (a motto or poem).
20. Set a four-page program for a music recital.
21. Lay out and set a newspaper advertisement with a rule border.
22. Set a tabular form with leaders as cross members and brass column rules.
23. Prepare stock for jobs to be printed—count and cut.
24. Lock up forms for press.
25. Prepare press for job—clean, oil, and ink.
26. 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.
27. Inspect printed forms; jog; wrap; label; and deliver.
28. Make scratch pads from scrap paper: perforate, pad, stitch (wire staple), bind top with gummed paper tape, trim.
29. Print, fold, wire stitch, trim and wrap for delivery booklet of eight 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 AND SIMPLE MECHANICS

I. **General Drawing**
- Orthographic Projection
- House Planning
- Design

II. **General Woodworking**
- Hand Woodworking
- Woodturning
- Machine Woodworking
- Wood Finishing and Upholstering

III. **General Metal Work**
- Art Metal—Spinning, Raising, Chasing, and Tooling
- Forge and Wrought-Iron Work
- Oxy-acetylene and Arc Welding
- Sheet Metal
- Machine Shop

IV. **Crafts**
- Leather
- Moulding
- Wood Burning
- Wood Carving
- Loom and Seat Weaving
- Picture Inlay and Cut-out Lettering
- Plastics

V. **Home Mechanics**
- Electricity
- Plumbing
- Heating
- Masonry
- Glazing
- Carpentry

VI. **Projects**
- Elementary Woodworking
- Advanced Woodworking
- Woodturning
- Art Metal
- Wrought Iron
- Sheet Metal
- Machine Shop
- Leather Shop
- Leather
- Cut-Out Lettering
- Picture Inlay
- Wood Burning
- Loom and Seat Weaving
- Plastics
- Molding
- Wood Carving

General Drawing

OPERATION UNITS

1. Sharpen a drawing pencil.
2. Plan a drawing and make layout.
3. Make a free-hand working sketch.
4. Draw vertical lines with T-square and triangles.
5. Draw horizontal lines.
6. Use correct lines and symbols in drawing.
7. Block out views.
8. Make front and top views.
9. Make three views.
10. Dimension a drawing.
11. Draw views with hidden edges.
12. Use the pencil compass.
13. Make arrow heads.
14. Make numerals.
15. Make upper case letters.
16. Make lower case letters.
17. Draw to scale.
18. Draw sectional views.
19. Make an auxiliary view.
20. Transfer measurements with dividers.
21. Divide a line into equal parts.
22. Draw an octagon.
23. Draw a hexagon.
24. Transfer or enlarge by squares.

25. Make a simple topographical drawing.
26. Plan a landscape.
27. Bisect an angle.
28. Bisect an arc.
29. Draw an ellipse.
30. Develop a pyramid-shaped object.
31. Develop a cone-shaped object.
32. Make a machine drawing.
33. Make a detailed drawing.
34. Make an electric wiring diagram.
35. Make a pictorial sketch.
36. Make a blue print.
37. Draw a simple floor plan.
38. Draw elevations.

GENERAL DRAWING INFORMATION UNITS

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

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. Lay out and 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. Lay out and 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 on the jointer.

The Bandsaw
1. Adjust the bandsaw.
2. Saw curves.
3. Safety 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 on the shaper.

The Mortiser
1. Set up and adjust the mortiser.
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 screw-chuck.
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 WOOWORK INFORMATION UNITS

1. The common woods.
2. Cutting and milling lumber.
3. The seasoning of lumber.
4. Standard grades and dimensions of lumber.
5. Plywood and veneer.
6. Laying out tools.
7. Planes.
8. Hammers and mallets.
9. Clamps and holding devices.
10. Boring and drilling tools.
11. Wood scrapers.
12. Coated woodworking abrasives.
13. Grinding and sharpening stones.
14. Chisels and gouges.
15. Woodworking joints.
16. Hardware.
17. The kinds of glue.
18. The kinds of stains and their uses.
19. Varnish.
20. Shellac.
21. Lacquer.
22. Paints and enamels.
23. Fillers.
24. Nails and brads.
25. Wood screws.
26. The parts of a plane.
27. The table saw.
28. The jointer.
29. The surfacer.
30. The bandsaw.
31. The shaper.
32. The mortiser.
33. The lathe.
34. The jig saw.
35. The types of circular saws.
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 jewelers 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 break-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. Cut hot metal with handled chisel.
43. 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 of iron.
30. Wrought iron and mild steel.
31. Safety rules for the engine lathe.
32. Safety rules for the shaper.
33. Safety rules for the forage.
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.

SUGGESTED PROJECTS

Art Metal

1. Ash trays.
2. Bowls.
3. Sugar bowl and creamer.
4. Candy dish.
5. Pin trays.
6. Serving trays.
7. Candle sconce.
8. Flower pots.
9. Desk sets.
10. Wall plaques.

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. Candle sticks.
14. Table lamps.
15. Floor lamps.
16. Tables with 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. Ball peen 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. Machinists clamps.
14. U-bolts.
15. Solder scrapers.
16. Hammer heads.
17. Hinges.
18. End wrenches.
19. V-blocks.
20. V-block clamps.

Home Mechanics

ELECTRICITY OPERATION UNITS

1. Read a wiring diagram.
2. Make a common splice.
3. Inspect and replace a fuse.
4. Wire series and parallel circuit.
5. Read an electric meter.
6. Plan and construct an electric circuit.
7. Attach cord to lamp socket.
8. Attach cord to electric plug.
9. Make an electromagnet.
10. Employ resistance to generate heat.
11. Tie underwriters knot.
12. Install wall switch.
13. Construct a simple electric meter.

ELECTRICITY INFORMATION UNITS

1. The kinds of conductors.
2. Insulating materials and nonconductors.
3. The properties of the magnet.
4. The source of electric current.
5. Producing heat, light, and power with electricity.
6. Phase and cycle.
7. Voltage, ampere, and watt.
8. Safety rules in electricity.

MISCELLANEOUS OPERATION UNITS

1. Care for a house furnace.
2. Patch plaster.
3. Mix and pour concrete.
4. Finish a concrete surface.
5. Replace a sash cord.
6. Lay out and cut a stop stringer.
7. Put wire on a screen.
8. Lay out and cut a rafter.
9. Repair a faucet.
10. Regulate mixer on a gas burner.
11. Remove stoppage from pipes.
12. Lay drainage tile.
13. Lay a flagstone walk.
14. Lay a stone wall.
15. Do simple glazing.
16. Insulate a house against heat and cold.

MISCELLANEOUS INFORMATION UNITS

1. The kinds of fuel.
2. Pipe fittings.
3. Sizes of pipe.
4. Plumbing fixtures and fittings.
5. Materials used in cement.
6. The grades and kinds of glass.
7. Types of roof framing.
8. The hot water system.
9. Screen wire.
10. Kinds of insulating materials.

Crafts

LEATHER WORK OPERATION UNITS

1. Transfer design on leather.
2. Tool leather.
3. Stipple background.
4. Punch holes for lacing.
5. Install fasteners.
6. Dye leather.
7. Finish leather.
8. Emboss a design.
9. Use overcasting stitch.
10. Use cross stitch.

LEATHER WORK INFORMATION UNITS

1. The leather industry.
2. Sources of leather.
3. Methods of tanning leather.
4. Types and sources of dyes.

LOOM AND SEAT WEAVING OPERATION UNITS

1. Cane a seat.
2. Weave art fibre.
3. Weave a split seat.

LOOM AND SEAT WEAVING INFORMATION UNITS

1. The source of cane.
2. How art fibre is made.
3. The making of splits.
4. Designs for art fibre and splits.

PICTURE INLAY AND CUT-OUT LETTERING OPERATION UNITS

1. Make a picture inlay.
2. Prepare design of letters.
3. Cut-out and assemble letters.

PICTURE INLAY AND CUT-OUT LETTERING INFORMATION UNITS

1. Picture inlay designs.

MOLDING OPERAION UNITS

1. Make a rubber mold.
2. Back up rubber mold.
3. Mixing and pouring a mold.
4. Finish molded article.

MOLDING INFORMATION UNITS

1. Molding materials.

WOODBURNING OPERATION UNITS

1. Transfer design to wood.
2. Burn design on wood.
3. Finish a woodburning plaque.

WOODBURNING INFORMATION UNITS

1. Designs for woodburning.

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. Saw plastic material.
2. Smooth a surface.
3. Turn plastics.
4. Drill holes.
5. Glue plastics.
6. Polish a surface.

PLASTICS INFORMATION UNITS

1. Manufacturing of plastics.
2. Plastics in industry.

Suggested Projects in Crafts

Leather Work

1. Key case.
2. Wallets.
3. Brief case.
4. Indian Tom Tom.
5. Waste baskets.
6. Belts.
7. Sandals.
8. Knife sheath.
9. Axe sheath.
10. Desk sets.

Molding

1. Book ends.
2. Wall plaques.
3. Paper weights.
4. Ornaments for novelty furniture.
5. Miscellaneous bric-a-brac for shelf decoration.

Plastics

1. Desk pen staff set.
2. Candle sticks.
3. Lamps and shades.
4. Book ends.
5. Letter holders.
6. Letter openers.
7. Napkin rings.
8. Costume jewelry.
9. Drawer pulls.
10. Clock frames.
11. Small boxes.
12. Salt and pepper sets.

Wood Carving

1. Book ends.
2. Letter holders.
3. Glove and handkerchief boxes.
4. Wastebaskets.
5. Silver chests.
6. Table rails.
7. Wall plaques.
8. Applied surface decoration on various projects.

Simple Mechanics

The following program is planned for those schools which are equipped with general shops in major areas and also offer a course of short units in a variety of industrial subjects approximating something of the general shop idea. This program provides a series of rapid-fire experiences in the use of several media and wide variety of tools. It merely serves as an introduction to the broad field of industrial education which is the foundation of our national economy. It is intended strictly as a sampling process, and as a means of aiding the pupils to explore their own capacities.

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 lawn-mower.
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 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. How to make putty.

INFORMATION UNITS

1. How to distinguish some of the more common woods, and know their principal characteristics and working qualities.
2. How to protect and preserve 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. Names of pipe fittings.
20. Sizes and kinds of pipe 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 Farm Shop is without a doubt the best type of Industrial Arts program for the rural community whether or not a Vocational Agriculture program is in operation. The vocational interests of the inhabitants of a locality should to a certain extent be considered in setting up a technical program on the secondary level. The average Kentucky community is rural and primarily interested in agriculture and for that reason the curriculum committee has included a Farm Shop program with the other Industrial Arts activities outlined in this handbook.

Based on the specific interests and needs of a community a group of projects from any of the following lists may be selected and effectively used to enable the learner to acquire an acceptable degree of skill in the various tool operations.

The time element is flexible and units may be set up for periods of from one to four years depending upon the stress to be placed upon this phase of the school program.

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 on interest in and understanding of materials such as woods, 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 tapeline 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 reassemble.
   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 ripsaw.
14. Use draw knife.
15. Use wood rasp.
16. Use nail set.
17. Use screw driver.
18. Use sandpaper.
19. Use dividers.
20. Compas 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.
       Set 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

1. Clean tools.
2. Decide what sharpening equipment to use.
3. Grind to proper angle with grindstone.
4. Use emery grinder.
   a. Grind to the proper angle.
   b. Prevent burning.
   c. Use emery wheel dresser.
5. Stone to cutting edge.
   a. Employ proper stroke.
   b. Remove wire edge.
   c. Test cutting edge.
6. Use files.
   a. Employ proper strike.
   b. Care for files.
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

1. Select hand tools.
   a. Select hand tools of proper size and design.
   b. Recognize quality of workmanship and materials.
      Handles.
      Metal parts.
      Finish.
   c. Recognize trade names and brands.
   d. Understand guarantees.

Leather Work

OPERATION UNITS

1. Repair and care for harness.
2. Replace worn or broken straps.
   a. Cut to proper length and width.
   b. Make stitched splice.
      Prepare ends of strap for splicing.
      Prepare harness thread.
      Mark guide lines.

Use stitching tools and do the stitching.
c. Make riveted splice.
Solid copper rivets.
Tubular rivets.
Split rivets.
3. Replace worn or broken fittings.
a. Select buckles, snaps, rings, clips, traces, etc.
b. Attach fittings.
4. Clean and oil harness.
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. Tack on new sole.
d. 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.
Hogs.
Ornamental.
f. Compare prices.
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 fnecing 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, bathtubs, 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 whitwash.
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 carbureter.
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. Understand 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 cord.
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 bushes.
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. Treament.
   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.
      Stone or brick, gravel, sand, cement, form material.
   b. Test material.
      Sand and gravel content of bank gravel; silt content of sand.
4. Decide on the proper mix.
   a. Concrete.
   b. Mortar.
5. Estimate costs.

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 hole 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

A List of Professional Books for Industrial Arts Teachers

Bawden, W. T., *et al.* *Industrial Arts in Modern Education.* The Manual Arts Press, Peoria, Illinois, 1934. Pp. 168

Bennett, Charles A. *History of Manual and Industrial Education up to 1870.* The Manual Arts Press, Peoria, Illinois, 1926. Pp. 461

Bennett, Charles A. *History of Manual and Industrial Education 1870–1917.* The Manual Arts Press, Peoria, Illinois, 1937. Pp. 566

Eaton, Theodore H. *Educations and Vocations.* John Wiley and Sons, New York, 1926. Pp. 300

Ericson, Emanuel E. *Teaching Problems in Industrial Arts.* The Manual Arts Press, Peoria, Illinois, 1930. Pp. 433

Lancelot, W. H. *Handbook of Teaching Skills.* John Wiley and Sons, New York, 1929. Pp. 198

Mays, Arthur B. *The Problem of Industrial Education.* The Manual Arts Press, Peoria, Illinois, 1927. Pp. 433

Monroe, W. S. *Encyclopedia of Educational Research.* The Macmillan Co., New York, 1941. Pp. 602–621

Sears, W. P. *The Roots of Vocational Education.* John Wiley and Sons, New York, 1931. Pp. 310

Selvidge, R. W. and Fryklund, V. C. *Principles of Trade and Industrial Teaching.* The Manual Arts Press, Peoria, Illinois, 1930. Pp. 419

Selvidge, R. W. *Individual Instruction Sheets.* The Manual Arts Press, Peoria, Illinois, 1926. Pp. 263

Struck, F. Theodore. *Foundations of Industrial Education.* John Wiley and Sons, New York, 1930. Pp. 492

Struck, F. Theodore. *Methods in Industrial Education.* John Wiley and Sons, New York, 1929. Pp. 214

Struck, F. Theodore. *Creative Teaching: Industrial Arts and Vocational Education.* John Wiley and Sons, New York, 1938. Pp. 623

APPENDIX B

A Selected Bibliography in Several Fields

Mechanical Drawing

Badger, Hale, Hill and McGinnis. *Introduction to Applied Drawing.* The McCormick-Mathers Co., Witchita, Kansas, 1938. Pp. 55

Berg, Edward and Kronquist, Emil F. *Mechanical Drawing Problems.* The Manual Arts Press, Peoria, Illinois, 1927. Pp. 223

Dalzell, J. Ralph and McKinney, James. *Architectural Drawing and Detailing.* American Technical Society, Chicago, Illinois, 1940. Pp. 212

Ericson, Emanuel E. and Soules, Roy L. *Planning Your Home.* The Manual Arts Press, Peoria, Illinois, 1938. Pp. 131

French, Thomas E. and Svenson, Carl L. *Mechanical Drawing.* McGraw-Hill Book Co., New York, 1940. Pp. 302

Fryklund, Vern C. and Kepler, Frank Roy. *General Drafting.* McKnight & McKnight, Bloomington, Illinois, 1938. Pp. 160

Giesecke, Frederick E., Mitchell, Alva and Spencer, Henry Cecil. *Technical Drawing Problems.* The Macmillan Co., New York, 1941

Hoelsher, R. P., and Mays, A. B. *Basic Units in Mechanical Drawing.* John Wiley and Sons, New York, 1933. Pp. 289

Mattingly, B. S., and Scrogin, Everett. *Applied Drawing and Design.* The McCormick-Mathers Publishing Co., Witchita, Kansas, 1940. Pp. 224

McGee, R. A., and Sturtevant, W. W. *General Mechanical Drawing.* The Bruce Publishing Co., Milwaukee, Wisconsin, 1940. Pp. 195

Townsend, Gilbert and Salzell, J. Ralph. *How to Estimate.* American Technical Society, Chicago, Illinois, 1940. Pp. 633

Waffle, Harvey W. *Architectural Drawing for High School.* The Bruce Publishing Co., Milwaukee, Wisconsin, 1940. Pp. 324

Woodwork

Douglass, J. H., and Roberts, R. H. *Instruction and Information Units in Hand Woodworking.* The McCormick-Mathers Publishing Co., Wichita, Kansas, 1939. Pp. 128

Fryklund, Vern C., and LaBerge, Armand J. *General Shop Woodworking.* McKnight & McKnight, Bloomington, Illinois, 1940. Pp. 152

Gottshall, Franklin H. *Simple Colonial Furniture.* Bruce Publishing Co., Milwaukee, Wisconsin, 1935. Pp. 124

Griffith, Ira Samuel and Cox, George B. *Woodwork for Secondary Schools.* The Manual Arts Press, Peoria, Illinois, 1937. Pp. 328

Hjorth, Herman. *Basic Woodworking Processes.* Bruce Publishing Co., Milwaukee, Wisconsin, 1940. Pp. 250

Hjorth, Herman. *Machine Woodworking.* Bruce Publishing Co., Milwaukee, Wisconsin, 1938. Pp. 384

Hjorth, Herman. *Principles of Woodworking.* Bruce Publishing Co., Milwaukee, Wisconsin, 1940. Pp. 307

Lukowitz, Joseph J. *Fifty Popular Woorworking Projects.* Bruce Publishing Co., Milwaukee, Wisconsin, 1938. Pp. 80

McGee, R. A. and Brown A. G. *Instructional Units in Wood Finishing.* Bruce Publishing Co., Milwaukee, Wisconsin, 1934. Pp. 128

Noyes, William, and Siepert, Albert F. *Handwork in Wood.* The Manual Arts Press, Peoria, Illinois, 1941. Pp. 258

Newell, A. C. *Coloring, Finishing, and Painting Wood.* The Manual Arts Press, Peoria, Illinois, 1940. Pp. 480

Roberts, William E. *Beginning Woodwork Units.* The Manual Arts Press, Peoria, Illinios, 1934. Pp. 96

Roberts, William E. *Woodwork in the Jnior High School.* The Manual Arts Press, Peoria, Illinois, 1930. Pp. 248

Smith, Robert E. *Information and Operation Units in Machine Woodworking.* McCormick-Mathers Publishing Co., Wichita, Kansas, 1938. Pp. 159.

Tustison, F. E. and Brown, A. G. *Instructional Units in Hand Woodwork.* Bruce Publishing Co., Milwaukee, Wisconsin, 1930. Pp. 222

Waring, Ralph G. *Wood Finising and Painting.* Bruce Publishing Co., Milwaukee, Wisconsin, 1941. Pp. 220

Metal Work

Berg, E., and Wing, B. E. *Essentials of Metalworking.* The Manual Arts Press, Peoria, Illinois, 1927. Pp. 159

Bick, A. F. *Artistic Metal Work.* Bruce Publishing Co., Milwaukee, Wisconsin, 1940. Pp. 236

Bollinger, J. W. *Elementary Wrought Iron.* Bruce Publishing Co., Milwaukee, Wisconsin, 1930. Pp. 139

Bollinger, J. W. *A Course in Sheet Metal Work.* Bruce Publishing Co., Milwaukee, Wisconsin, 1939. Pp. 96

Broemel, L., and Daugherty, J. S. *Sheet Metal Worker's Manual* Frederick J. Drake & Co., Chicago, Illinois, 1935. Pp. 541

Butler, John B. *Metalwork Job Sheets.* The Manual Arts Press, Peoria, Illinois, 1929. 26 job sheets

Campbell, Harry L. *Metal Castings.* John Wiley & Sons, New York, 1940. Pp. 318

Campbell, Harry L. *The Working, Heat-Treating and Welding of Steel.* John Wiley & Sons, New York, 1940. Pp. 230

Giachino, J. W. *Oxy-Actelyene Welding.* The Manual Arts Pres, Peoria, Illinois, 1939. Pp. 96

Grayshon, Thomas. *General Metal Work.* D. Van Nostrand Co., New York, 1930. Pp. 206
How to Run a Lathe, published by South Bend Lathe Works, South Bend, Indiana, Revised Edition No. 27

Jennings, R. F. *General Shop Gas and A. C. Arc Welding and Cutting.* McKnight & McKnight, Bloomington, Illinois, 1937. Pp. 63

Johnson, Carl G. *Forging Practice.* American Technical Society, Chicago, Illinois, 1941. Pp. 136

Lemos, Pedro J. *Arts Metal Craft.* Davis Press, Worcester, Massachusetts, 1937. Eight Plates.

Lukowitz, Joseph J. *Interesting Art Metal Work.* Brue Publishing Co., Milwaukee, Wisconsin, 1938. Pp. 63

Palmer, R. H. *Foundry Practice.* John Wiley and Sons, New York, 1929. Pp. 450

Peterson, L. C. *101 Metal Working Projects.* Bruce Publishing Company, Milwaukee, Wisconsin, 1929. Pp. 214

Reagan, J. E., and Smith, E. E. *Metal Spinning.* Bruce Publishing Company, Milwaukee, Wisconsin, 1936. Pp. 80

Selvidge, R. W., and Christy, E. W. *Instructional Manual for Sheet-Metal Workers.* The Manual Arts Press, Peoria, Illinois, 1939. Pp. 167

Smith, Robert E. *Units in Bench Metal Work.*
McCormick-Mathers Publishing Co., Wichita, Kansas, 1939. Pp. 48

Smith, Robert E. *Units in Patternmaking and Foundry.*
McCormick-Mathers Publishing Co., Wichita, Kansas, 1939. Pp. 72

Smith, Robert E. *Units in Sheet Metal Work.*
McCormick-Mathers Co., Wichita, Kansas, 1939. Pp. 48

Tustison, F. E., and Kranzusch, R. F. *Metalwork Essentials.*
Bruce Publishing Co., Milwaukee, Wisconsin, 1936. Pp. 176

Welch, R. L. *Elements of Sheet Metal.*
Bruce Publishing Co., Milwaukee, Wisconsin, 1926. Pp. 122

Electricity

Burling, B. B., and Karweik, A. M. *Elementary Electricity and Electric Wiring.* Bruce Publishing Co., Milwaukee, Wisconsin, 1941. Pp. 96

Burling, B. B. *Preparatory Electricity*
Bruce Publishing Co., Milwaukee, Wisconsin, 1928. Looseleaf

Bruns, Elmer E. *Electricity, a Study of First Principles.*
D. Van Nostrand Co., New York, 1930. Pp. 233

Dragoo, K. L., and Dragoo, A. W. *General Shop Electricity.*
McKnight & McKnight, Bloomington, Illinois, 1941. Pp. 124

Esty, W., Millikan, R. A., and McDougal, W. L. *Elements of Electrcity.*
American Technical Society, Chicago, Illinois, 1940. Pp. 254

Hathaway, K. A. *Modern Radio Essentials.*
American Technical Society, Chicago, Illinois, 1941. Pp. 247

Jones, E. W. *Essentials of Applied Electricity.*
Bruce Publishing Co., Milwaukee, Wissconsin, 1935. Pp. 258

Jones, E. W. *General Electricity.*
McCormick-Mathers Publishing Co., Wichita, Kansas, 1937. Pp. 89

Peterson, C. F. *Fundamentals of Electricity.*
Bruce Publishing Company, Milwaukee, Wisconsin, Pp. 112

Timbie, W. H. *Elements of Electricity.*
John Wiley & Sons, New York, 1937. Pp. 307

Timbie, W. H. *Industrial Electricity.*
John Wiley & Sons, New York, 1939. Pp. 635

Willoughby, G. A. *Electric Motor Work.*
The Manual Arts Press, Peoria, Illinois, 1930. Pp. 196

Willoughby, G. A. *General Electrical Work.*
The Manual Arts Press, Peoria, Illinois, 1936. Pp. 95

Willoughby, G. A. *Practical Electricity.*
The Manual Arts Press, Peoria, Illinois, 1932. Pp. 104

Automotive

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John Wiley and Sons, New York, 1938. Pp. 363

Kates, Edgar J. *Diesel Electric Plants.*
American Technical Society, Chicago, Illinois, 1941. Pp. 435

Kuns, Ray F. *Automotive Essentials.*
Bruce Publishing Co., Milwaukee, Wisconsin, 1940. Pp. 435

Kuns, Ray F. *Automotive Service,* Volume 1.
Bruce Publishing Co., Milwaukee, Wisconsin, 1941.

General Shop and Simple Mechanics

Amateur Craftman's Cyclopedia of Things to Make.
Popular Science Publishing Co., New York, 1937. Pp. 338

Ashcroft, C. C., and Easton, J. A. G. *General Shop Work.*
The Macmillan Co., of Canada Limited, Toronto, 1940. Pp. 239

Bang, E. E. *Leathercraft for Amateurs.*
The Beacon Press, Inc., 1936. Pp. 114

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Cramlet, R. C. *Fundamentals of Leathercraft.*
Bruce Publishing Co., Milwaukee, Wisconsin, 1939. Pp. 61

Dodds, R. E. *Handicraft as a Hobby.*
Harper and Brothers, New York, 1939. Pp. 135

Dougherty, J. W. *Pottery Made Easy.*
Bruce Publishing So., Milwaukee, Wisconsin, 1939. Pp. 192

Dragoo, A. W., and Dragoo, K. L. *General Shop Metal Work.*
McKnight and McKnight, Bloomington, Illinois, 1936. Pp. 70

Frazier, C. *The Practical Book of Home Repairs.*
Thomas V. Crowell Co., New York, 1925. Pp. 378

Hewitt-Bates, J. S. *Bookbinding for School.*
The Manual Arts Press, Peoria, Illinois, 1935. Pp. 125

Hunt, W. B., and Metz, J. J. *The Flat Bow*
Bruce Publishing Co., Milwaukee, Wisconsin, 1936. Pp. 70

Lemos, P. J., and Lemos, R. A. *Color Cement Handicraft.*
The Davis Press, Worchester, Massachusetts, 1924. Pp. 201

Mansperger, Dale E., and Pepper, Carson W. *Plastics: Problems and Processes.* International Textbook Co., Scranton, Pennsylvania, 1938.

Orman, P. *Handloom Weaving.*
Sir Isaac Pitman & Sons, Limited, London, England, 1926. Pp. 99

Willoughby, G. A., and Chamberlain, D. C. *General Shop Handbook.*
The Manual Arts Press, Peoria, Illinois, 1936. Pp. 94

Woddin, J. C. *Home Mechanics for Girls.*
McCormick-Mathers Co., Wichita, Kansas, 1938. Pp. 121

Printing

Crispin, F. S. *Dictionary of Technical Terms.*
Bruce Publishing Co., Milwaukee, Wiscinsin, 1940.

Hague, C. W. *Printing Job Sheets, Revised.*
Bruce Publishing Co., Milwaukee, Wisconsin.

Henry, F. S., *Printing—School and Shop.*
John Wiley and Sons, New York.

Karch, R. R. *Printing and the Allied Trades.*
Pittman Publishing Co., New York.

Perry, R. W. *Block Printing Craft.*
The Manual Arts Press, Peoria, Illinois, 1941. Pp. 143

Perry, Kenneth F., and Boab, Clarence T. *The Binding of Books.*
The Manual Arts Press, Peoria, Illinois, 1940. Pp. 160

Polk, Ralph W. *Elementary Platen Presswork.*
The Manual Arts Press, Peoria, Illinois, 1931. Pp. 148

Polk, Ralph W. *Essentials of Linoleum Block Printing.*
The Manual Arts Press, Peoria, Illinois, 1927. Pp. 60

Polk, Ralph W. *Practice of Printing.*
The Manual Arts Press, Peoria, Illinois.

Rice, William S. *Block Printing.*
Bruce Publishing Co., Milwaukee, Wisconsin.

Farm Shop

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Farm Shop Work, Georgia State Board for Vocational Education, Bulletin 18

Methods of Teaching and Organizing Farm Shopwork, Missouri State Dept. of Education, Bulletin 24

Shopwork for Rural High Schools, Michigan State Board for Vocational Education, Bulletin 233

Some Aids in Teaching Farm Shop, Virginia Polytechnic Institute, Vol. 34, No. 12

Farm Shop Activities and Equipment, University of North Carolina, Division of Teacher Training

The Farm Shop and Tool Equipment, Cornell Bulletin 108

GENERAL

Cook, Scranton, and McColly. *Farm Shop.* The Interstate, Danville, Illinois

Roehl. *Farmer's Shop Book.* The Bruce Publishing Company, Milwaukee, Wisconsin

Farm Enterprise Mechanics, Edited by Davis Lippincott

Dickinson. *Job Operations in Farm Mechanics.* The Interstate, Danville, Illinois

Cook. *380 Things to Make for Farm and Home.* The Interstate, Danville, Illinois

The Farm Shop, Kansas Engineering Experiment Station, Bulletin 22

Handicraft Club Work, Michigan Club Bulletin 11B

Farm Shop Jobs, Clemson College Agricultural Education, Bulletin 14

CARPENTRY

Griffith, I. S. *Carpentry.* Manual Arts Press, Peoria, Illinois

Hjorth, H. *Basic Woodworking Processes.* Bruce Publishing Co., Milwaukee, Wisconsin.

Townsend, G. *Carpentry.* Manual Arts Press, Peoria, Illinois

CONCRETE AND MASONRY

Briggs and Cawer. *Practical Bricklaying.* McGraw-Hill Book Co., New York

A Practical Course in Concrete Construction. Portland Cement Association

Masonry Mortar. National Lime Association

Construction of Chimneys and Fireplaces, Farmers Bulletin 1649

Testing Gravel for Farm Concrete Construction, North Dakota Circular 129

Simple Tests for Impurities in Sand to be Used for Concrete on the Farm, Minnesota Circular 34

Quality Concrete for Farm Improvement, Portland Cement Association

Permanent Farm Construction, Portland Cement Association

Small Concrete Construction on the Farm, Farmers' Bulletin 1480

DRAWING AND BLUEPRINT READING

Dalzell, McKinney, and Retow. *Blueprint Reading for the Building Trades.* The American Technical Society, Chicago, Illinois.

Diamond. *A Primer of Blueprint Reading.* Bruce Publishing Co., Milwaukee, Wisconsin

Fryklund and Kepler. *General Drafting.* The Macmillan Co., New York

ELECTRICITY

Willoughby, G. A. *Fundamentals of House Wiring.* Manual Arts Press, Peoria, Illinois

Wright. *Electricity in the Home and on the Farm.* John Wiley & Sons, New York

How to Estimate the Cost of Wiring, Equipment, and Electrical Service for the Farmstead. Kentucky Circular 315

Farmstead Wiring, Minnesota Special Bulletin 179

Electric Wiring for the Farm, Cornell Bulletin 204

FENCING

Farm Fences, Farmers' Bulletin 1832

Fence Guide, Pittsburgh Steel Company Booklet 409

Effect of Treatment on Fence Posts, Missouri Bulletin 374

FORGE WORK

Ilgen. *Forge Work.* American Book Company

Selvidge and Allton. *Blacksmithing.* The Manual Arts Press, Peoria, Illinois

HOME MECHANICS

Bedell and Gardner. *Household Mechanics.* International Text Book Co., Scranton, Pennsylvania. (Suitable as references for shop work in prevocational agriculture.)

Whitman. *First Aid for the Ailing House.* McGraw-Hill Book Co., New York

Farm Home Conveniences, Farmers' Bulletin 927

Built-in Bedroom Closets, Missouri Circular 350

LAND ENGINEERING

How to Solve Simple Problems in Land Measurement, Kentucky Agricultural Engineering Mimeograph

Farm Drainage, Farmers' Bulletin 1606

Farm Terracing, Farmers' Bulletin 1669

A Simple Inexpensive Farm Level, Minnesotta 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 Borthers, Detroit Michigan
Outside Paints and Painting, Iowa Extension Circular 227
The Handbook on Painting, National Lead Company

PLUMBING

Wright. *Rural Water Supply and Sanitation.* John Wiley & 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 Co., 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 Co., Niagara Falls, New York

APPENDIX C

Magazines and Periodicals for Industrial Arts Teachers and Students

The Deltagram. 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. $2.50)

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, ashington, 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:

The Carborundum Co. (7)
Niagara Falls, N. Y.

Thurston Supply Co. (2)
Anoka, Minnesota

Wausau Abrasive Co. (2)
1500 S. Western Ave.
Chicago Illinois
Wasau, Wisconsin

AUTOMOTIVES:

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

Eau Claire Auto Supply Co.
Eau Claire, Wisconsin

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

Snap-On-Tools, Inc. (3)
Kenosha, Wisconsin
San Francisco, Calif.
New York, N. Y.
Atlanta, Ga.
Chicago, Illinois

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

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

CEMENTS:

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

Geo. B. Smith Chemical Co.
Springfield, Illinois

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

CRAFTS:

Boy Scouts of America
9 Washhington St.
Chicago, Illinois

William Dixon, Inc. (2)
36 E. Kinney St.
Newark, N. J.

Eagle-Ottawa Leather Co.
205 Ellis St.
Grand Haven, Mich.
Chicago, Ill.
St. Louis, Mo.
New York, N. Y.
Boston, Mass.
San Francisco, Calif.

Grayton & Knight (2)
Worcester, Mass.

Hobby Club Supply Co.
Janesville, Wisconsin

Indian Archery & Toy Co. (2)
Evansville, Indiana

Lackawanna Leather Co.
Hackettstown, N. J.

Leather Craft Supply Co.
Amos Station
Omaha, Nebraska

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

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

The Waldcraft Co.
Indianapolis, Indiana

DRAWING:

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

Eugene Dietzgen & Co. (9)
2425 Sheffield Ave.
Chicago, Illinois
Milwaukee, Wisconsin
Pittsburgh Pennsylvania
Los Angeles, California
New Orleans, Louisiana

Keuffel & Esser Co. (4)
300 Adams St.
Hoboken, N. J.
New York, N. Y.
Chicago. Ill.
St. Louis, Mo.
San Francisco, Calif.

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

Frederick Post. Co. (9)
310 S. Michigan Ave
Chicago, oIllinois
Milwaukee, Wisconsin

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

U. S. Blue Print Paper Co. (3)
207 S. Wabash Ave.
Chicago, Illinois

ELECTRICITY:

Allis Chalmers Mfg Co. (2)
427 East Stewart
Milwaukee, Wisconsin

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. (3)
1501 Graybar Building
New York, N. Y.
(in all principal cities)

Lussky, White & Coolidge
69 W. Lake St.
Chicago, Illinos

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.

Wagner Electric Corp. (2)
6410 Plymouth Ave.
St. Louis, Missouri

Westinghouse Electrical & Mfg. Co. (2)
East Pittsburg, Pa.
(in all principal cities)

Western Electric Co.
Chicago, Illinois

METAL WORK:

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

E. C. Atkins, Inc.
402 S. Illinois St.
Indianapolis, Ind.

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

H. Dsston & Sons, Inc.
Land Title Bldg.
Philadelphia, Pa.

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

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

Lufkin Rule Co. (2)
Saginaw, Michigan

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

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

Millers Falls Co. (2)
Millers Falls, Mass.

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

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

The Pewtercrafters (2)
29 Meadow Ave.
Bronxville, N. Y.

Rockford Drilling Machine
Rockford, Illinois

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

South Bend Lathe Works (6)
500 E. Madison St.
South Bend, Indiana

Stanley Rule & Level Co.
New Britain, Conn.

L. S. Starrett Co. (2)
101 Crescent St.
Athol, Massachusetts

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

White Metal Rolling and Stamping 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 St.
Portland, Oregon

Klise Manufacturing Co.
Grand Rapids, Michigan

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

WIRE:

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

WOODWORK:

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

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

Brodhead-Garrett Co. (3)
Cleveland, Ohio

Buck Brothers
Millbury, Massachusetts

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

Commercial Decalcomania 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.
5775 N. Holton St.
Milwaukee, 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. (2)
4th Ave. and 13th St.
New York, N. Y.

S. C. Johnson & Co.
Racine, Wisconsin

Klise Mfg. Co. (2)
60 Cottage Grove
Grand Rapids, Mich.

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

Lussky, 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
Glouchester, 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, Ohklahoma

Thurston Supply Co.
Anoka, Minnesota

Yates-American Machine Co.
Beloit, Wisconsin

Entered

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