BOAT BUILDING IN SCHOOL SHOPS

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By

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CHAPTER I

PRELIMINARY STATEMENTS

Industrial education has expanded tremendously during the past quarter of a century. This expansion has resulted from the activities of the American Vocational Association and leaders in the field of Industrial Arts Education who have worked diligently in the formulation of principles and objectives to be attained by students enrolled in these fields of study.

The demand of Industrial Arts teachers and of administrators in the field of general education for a more extensive program of shop activities, has resulted in a broading of that phase of the school curriculum. The expansion of industrial arts in modern education has provided an opportunity for a more universal background of information and experiences in industrial living by appealing, in a greater measure, to the interests of the student.

As a result of this expansion resulting from a program of studies based on the interests of the pupil, a suggestion is made in this study for another shop activity that commands a universal appeal for all classes and races.

The Origin of the Problem. The pleasure and satisfaction this writer has experienced in the field of boat building and boating activities has been a strong factor in providing an incentive for making this study. A further

acceleration of this incentive has resulted from the possibilities seen in plywood construction for boats. This new method of construction adaptable to boat building has been made possible only since the production of large panels of resin-bonded plywood which is waterproof and ideally suited to marine use. The more recent development of a powdered resin glue that provides a permanent waterproof joint for wood construction is still another point in favor of plywood construction for boats, in that it provides a more complete utilization of the "stressed cover" principle important in hulls of this character. Plywood construction is easy to understand and execute, and has opened a field of shopwork for the amateur, heretofore beyond the scope of the average industrial arts shop.

The Aims of the Study. The purposes of this study are twofold; first, it is designed to present a background of general information on the subject, and second, to provide a solution for the problem of organizing and teaching a course in boatbuilding adaptable to the needs of Oklahoma. These purposes have been partially achieved by presenting the results of an examination of current published material and by presenting a course of study outline for the construction of plywood boats which is based on the experience of this writer, and course of study outlines being used in other states.

Deliminations. The scope of the term "boat building" is practically unlimited in its implications, therefore, it has been necessary to limit this investigation and study to that phase of boat building that contributes to a plan of information and activities suitable for use and application to Oklahoma and to school shops in Oklahoma. Those conditions that contribute to this study as just suggested are briefly outlined as follows: (1) evolution of boat building; (2) appropriateness of the subject; (3) the literature of the field; (4) a boat suitable for Oklahoma; and (5) a suggested course of study.

The Techniques of the Research Used in This Study. This thesis cannot truly be called a research problem, although much of the contents required assemblage of data having no previous organization.

Most of the information obtained for the review of the boat building courses in operation throughout the United States was in answer to informal letters written to possible informants. A questionnaire was used to a limited degree but only as an outline for some of the answers required. A copy of the inquiry form used is included as Appendix B. Due to the diversity of the boat building programs being carried on, a comprehensive questionnaire either would not have been appropriate for general distribution or would not have been conclusive in the information secured by its means.

The data used in developing that part of this study concerning the numerous lakes of Oklahoma were obtained from Charles J. Brill, editor of The Oklahoma Rochet, Oklahoma City, Oklahoma.

All of the books and many of the periodicals listed in the chapter devoted to the literature of the field, are in the private library of this writer. Almost without exception, the references quoted in this study are found in this library. The nature of the subject and the recency of its popularity have not warranted the consideration of public and school libraries, therefore, this collection was purchased specifically to serve as an aid in the development of this problem.

A Review of Two Theses in Boat Building. Only two theses on boatbuilding in schools have been found that have a bearing on this study. One of these is an exploratory unit in junior high schools and the other is written somewhat as a text. These titles were found after searching the office of Education Lists of Theses for the last ten years. They are named and reviewed here:

Devers Langdon Pierce, Boat Building Exploratory Unit in Junior High School Industrial Arts, Master's thesis, University of Wisconsin, 1933, 113 pages. (Express charges $1.30)

This study is a discussion of the general aims of education and how a psychological curriculum would provide a means of their attainment, by the teaching of skills and information involved in the building of a model boat. A model boat building unit is presented by the author.

Stevenson, James E., A Course of Study in Boat Building for Secondary Schools, Master's thesis, Leland Stanford Junior University, 1936, 106 pages. (Express charges $.90)

This thesis is developed in a manner similar to the content of a textbook in boat building. The writer presents a development of present types of boats and some of the basic considerations in the procedure of their construction. There are twenty-five illustrations and charts that add to the appearance of the work but very little if any authenticity is given for them or the text itself.

The two theses were secured by the Oklahoma A. & M. College library on an inter-library loan basis which made them available for study in connection with the preparation of this thesis. Both theses were written in boating states, one in Wisconsin and one in California.

The material presented by the two theses just reviewed has been of some indirect benefit to this writer, because they have indicated the trend of thinking and the opinions of some educators in other sections of the country, relative to the subject of this study.

The Literature of the Field. The number of books available for the development of this problem is not great. These that can be secured are written for the use of the amateur in securing information on how to build boats and practically no mention is made in any of them regarding their use as textbooks, however, much practical aid has been gained from them in the pursuance of this study. The names of these books are given in the chapter on "The Literature of Amateur Boat Building."

A few periodicals have been used for more recent data in the scope of this study but the offering is limited as is indicated by the list given in the chapter just named.

An examination of the literature mentioned in this problem and a study of the suggested course of study outlined in these pages, should be of much help to a teacher, who proposes to organize a course in boat building, and in addition, should prove to be of considerable help to the amateur boat builder.

The Plan of the Study. Chapter II will be devoted to the influences affecting the development of primative boats and their relation to present day achievements in this field. Other chapters of this study will present the present day literature of the field and a suggested course of study outline suitable for use in teaching boat building in school shops. The appropriateness of this course for use in many Oklahoma school shops is an important part of this study. The physical characteristics of the state and the course of events leading up to the present opportunities existing in Oklahoma indicate the possible value of objectives suggested in this study.

CHAPTER II

THE SIMILARITY OF INFLUENCES REFLECTED IN PRIMATIVE AND MODERN BOAT BUILDING

The conquests and achievements on the sea are functions which parallel the story of man's progressive nature to evolve the best boat or ship possible, with the materials at hand. The type of rig and construction, though limited by geographical location and climatic conditions, has been a result of the needs of the race to provide itself with the mobility necessary for its perpetuation. The boat and ship building programs being maintained by the nations of the world today, are based on the building material that is available for it. The efficiency and desirability of the finished product is predetermined and limited by the qualities of the material that is used in its construction. Ancient man was restricted in this same respect, and a criticism of his achievements is warranted, only if this fact is borne in mind.

The different factors influencing the results of ancient man's attempt at boat building, and the evolution of present day types of boats and their construction is an important consideration in determining the technique of precedure in teaching and training modern people in this age-old craft.

For generations, the trade secrets of the ship building and boat building industry have been handed down from

father to son. The apprenticeship system of training has been maintained in a very narrow sense, resulting in the prevention of an understanding of the industry by the average layman who has had no means of securing knowledge of the job processes used in the ship yards.

During recent years, however, progressive ship builders, cooperating with the educational agencies of America, have begun a program of vocational training which has done much to make available to more individuals the knowledge of ships that has long been considered trade secrets. Many private and public schools have maintained industrial arts classes in which boat building has been taught and since the beginning of the present international crisis, the American government has financed many schools in states of the coastal areas, so that a defense program could be maintained for the training of ship fitters, ship carpenters, boat builders, and other related craftsmen.

THE ORIGIN AND EVOLUTION OF MAN'S LIFE AFLOAT

The beginning of man's life afloat is hidden in the dim mists of time and past ages. Undoubtedly, man accidentally discovered the merits of a waterbourne log as a support for his weary body, or the buoyant qualities of a bundle of grass or reeds may have been observed. The use of either of these methods of supporting objects on the surface of the water was slow to be appreciated. It was a long process for

man to evolve a dougout canoe from the observation of the floating log and probably just as long to devise a method of weaving reeds and grass to form a craft for the support of his own weight.

Primitive Craft. In early centuries, as he does today, man has always had to keep in mind the controlling depth of water on which he sailed. He was compelled to govern his actions by the effects of wind, tide, current, and temperature on his surroundings and in doing so, developed a craft suitable to the conditions under which it was used. Boats identical to many of these primative craft are in use today, and answer admirably in fulfilling the original purpose for which they were designed.

The Eskimo developed the kayak, a small skin covered canoe, that provided him with a suitable boat for use in the ice floes of the Arctic in his hunting and fishing expeditions for food. The materials used in the construction of the kayak were native of the area in which the Eskimo lived. They consisted chiefly of great bones with the skin of the seal being used for covering.

In India, where reed and grasses grow in abundance in many sections of the country, a boat was evolved from the use of this material in its construction. This type of boat could only be used on the inland water areas but it fulfilled the original requirements.

The South Sea Islander, having need for a boat to travel across open stretches of the sea to the other islands visable on the horizon, used the native materials of his home to make a light narrow boat similar to the Eskimo kayak but fitted with an outrigger. The outrigger may have been only a bamboo pole but it served its purpose in preventing the surf canoe from capsizing when riding the mountainous waves of the rolling sea.

The dense forests of Africa and South America that provide abundant timber, such as mahogany and teak, ideally suited to use in making a boat, may account for the widespread interest the native of those countries have shown in making dougout canoes and boats.

The examples of primative craft given in the preceding paragraphs may serve to emphasize the effect that local conditions and needs has been in the development of boats. This is directly applicable to the types of boats used in the various parts of the world and the different coastal regions of America today.

Boats and Ships of American Waters. The waters of the United States are varied, each resulting in the development of a type boat suitable for use on them. In navigating the shallow inland rivers of America, the "Punt" has proved satisfactory because of the flat and wide beam that minimizes the draft found only in this type.

The "Sharpie", or skiff, similar to the punt but having a pointed bow, has had wide acceptance on the inland lakes and larger rivers of America because of its adaptability to rowing and sailing. The "Dory" similar to the sharpie, but narrower and deeper has proved satisfactory as a small boat for fishing on the open sea. The ease and cheapness of the construction of the three boats just mentioned has been a deciding factor in their widespread use.

The self-bailing surf boat, designed for use by the United States Coast Guard, is used for rescue work in any kind of weather on the high seas. It is expensive to build but the type of construction used insures the safety of many lives that might be lost at sea. It is self-bailing, the water breaking in over the sides, being drained automatically back into the sea.

In addition to the small boats already described that are used on the sea, there is that multitude of types and sizes that are used for fishing, both commercial and pleasure; those used for whaling; tug boats for towing large steamers into their berths; the commuter-cruiser used by the business man to go to and from his work; and many others used for pleasure. The ocean going pleasure boats of America form a large portion of the boats in use today. The types and rigs are too numerable to mention but among them are the motor cruisers, sailing auxiliary cruisers, day sailers, racing sailers, and that host of small, modern motorboats and sail-

boats that can be handled by one or two members of the crew and yet provide fun and sport comparable to that derived in operating the larger ocean going vessels.

On the inland lakes and waterways of America the small outboard motorboat has gained popularity in recent years since the development of light weight portable motors. The small sailboat is being accepted and widely used throughout the interior of America where it has created considerable interest as indicated by the numerous yacht clubs that have been organized to provide better means of planning and holding sailing regattas. The organization of yacht clubs in many areas of America has been a result of the Federal Conservation Projects that provided hundreds of lakes throughout the United States.

This study is chiefly concerned with the boats used in the inland lakes of this country, particularly Oklahoma, and the methods suitable for building them. As a basis in selecting a type of boat suitable for use in Oklahoma, and in determing a method of teaching the procedures necessary in its construction, an examination of the boat building schools and classes will be required.

BOAT BUILDING IN THE SCHOOLS OF THE UNITED STATES

The apprenticeship system of training as followed by the ship building and boat building industry has provided small opportunity for the schools of America to devise a

program of boat building instruction that would meet with the approval of industry. During recent years, the introduction of new materials and new methods into this old industry has tended to open jobs for men who understood the possibilities they provided. For example, the introduction of steel for ship construction, the application of arc welding to steel hulls, and the benefits derived from waterproof plywood in making light weight boats, have all contributed to a greater breadth and interdependency of the several divisions of the ship building industry. These latter developments have progressed faster than the old system of training workman has progressed and has resulted in outside agencies being used to aid in this training. Vocational schools and classes, and most recently, defense training centers are providing instruction in boat building, ship building, and the related skills of the trade.

Vocational Schools and Classes. Educational agencies of America have made a significant contribution to the training of individuals who have not yet entered college to fill their places in society. This has been done by industrial arts departments, technical high schools and vocational trade and industrial departments organized under federal subsidy and control. In many areas where ship yards are operated, there are local schools that provide vocational training in this field. Although, schools of this type have not been in progress for many years, there is evidence of a more extensive program in the future.

In 1928, J. I. Sowers, who is at present the Director of Industrial Arts at Miami, Florida, organized a course in boat building in that city. At that time the school district had just finished a large shop building, fifty by two hundred feet with an annex almost one-fourth as large. The cost of securing adequate shop equipment for the regular industrial arts or vocational shop program was prohibitive. Boat building courses were begun because few machines were needed in this program of instruction and the large roomy shop was available for large projects such as boats. Two instructors were obtained for the purpose of teaching the course which was of a vocational nature. A man who had spent many years as a professional boat builder, and a qualified teacher of shop classes were employed. The former provided the background of experience and the latter worked out organized subject material and organized the course.

This vocational or trade training has been in operation since its first organization almost fifteen years ago and because of the success of the program it has been given some attention in the pages of the various boating magazines and industrial education publications. The classes have produced large and small boats of all types, some of them, regular sea-going boats sixty feet in length. The cost of the material is furnished by the individual who wants the boat built, therefore, the school has no expense in this connection.

Captain Leonard Clark, West Palm Beach, Florida, has been connected with a vocational boat building program there for the past eight years, but at present his classes are devoted to defense training.

The Barnstable High School, Hyannis, Massachusetts, has provided vocational training in boat building for many of their students during the four years since their organization of the vocational program in this field. Students in each of the four grades in high school are given an opportunity to obtain training in boat building. The program is divided into two parts, the academic work in the morning and boat building in the afternoon. Fifteen hours are spent in the class room and twenty hours are spent in the shop each week. The shop work is done in the plant of the Crosby Yacht Building Company, located at Osterville, which is six miles from the high school. During the school year 1941-42 the boys built and finished eight rowboats, one Wianno Junior Knockabout, and a fourteen foot catboat, all of which were sold to the Crosby Company for a total of $1650 as they were built to that company's rigid specifications. Approximately a dozen boys participated in the work. Barnstable High School is the only high school in Massachusetts this writer has been able to discover that teaches boat building. Frederick M. Hodge, principal of the Barnstable High School, makes this statement in a letter dated January 13, 1942, "I believe that this is the only course in boatbuilding offered in a

Massachusetts high school." There are probably many defense classes in boatbuilding at the present time, but this thesis is not concerned with that problem.

The Edison Vocational School of Boat Building, Seattle, Washington, has been in operation for nearly six years but at the present time is devoted to defense training.

J. C. Beswick, Chief, Bureau of Trade and Industrial Education, Sacramento, California, reports that Antioch High School, Antioch, California, has a program of vocational training in boat building, but the extent of their program has not been ascertained.

The five schools just described are all that have been described in recent periodical literature. One other vocational class was held for about a year at Eastport, Maine, under the direction of Gordon Botkins but has been discontinued. The course there consisted of actual work on fishing vessels twenty-five to fifty feet in length.

The number of people being trained for boat building by the regular vocational education program in America is not great. According to a recent bulletin, there were 231 students in day trade courses and 126 acquiring the apprentice level of training. This is certainly not an indication of the tremenduous number of workmen being used in the war production program being maintained at the present time. Most of the training for these men is carried on under the

heading, "Defense Training", and is a more intensified and specialized program than the one previously mentioned.

Defense Training in Boat Building. It is beyond the scope of this study to attempt an analysis of the defense training being done at the present time. In brief, most of the states along the coasts of America are training men to go into shipyards, and relatively little training is being offered in actual boat building. These trainees are given instruction in the various schools to qualify them as ship fitters, ship carpenters, plumbers, electricians, or other specialized workmen in the industry.

Boat Building in Industrial Arts Classes. There are relatively few industrial arts classes that teach boat building as a separate course but there have been hundreds of students in school shops that have produced a completed boat as a woodworking project. In some cases students have been interested in boat building only to be discouraged by uninterested and unsympathetic instructors.

One of the finest examples of boatbuilding as a non-vocational school activity may be seen at Proctor Academy, Andover, New Hampshire. The school there has offered boat building courses in the curriculum for the past five years and has been increasingly successful from year to year.

Proctor Academy is a small boarding school limited to fifty boys. It is located in the central part of the

state near the White Mountains. The importance of this school in the present emergency may be estimated from the following statement made by Fred R. Nichols. (11,page 16)

> With the somewhat frenzied attempts being made by the state and federal governments and private agencies to train men and boys as boat builders, it is interesting to see the contribution that one of our New England boarding schools is making.

This school does not attempt to give vocational training to its students but some of them have gone directly from school into the shipyard. The original purpose in organizing the boat shop was to provide a means of training boys in skills requiring the use of their hands and at the same time insure adequate use of leisure time. From a letter received by this writer from W. J. Shinn, one of the boat building instructors at Proctor, this statement regarding the purposes and value of the course is quoted.

> It is used primarily to encourage the use of hands, to give boys who have experienced nothing but failure in previous studies, a sense of accomplishment.
> We have found that improvements in coordination, and speed in the use of hands results in a similar improvement in studies.

The merits of the course may be judged by the extent of its growth. During the past few years an average of thirty-five boats each year have been built by the boys in the shop, and the gymnasium, originally housing the boat shop has been replaced by a two and one-half story building that provides ample floor space for the building of fifty boats at the same time.

The use of leisure time is adequately supervised at Proctor Academy. A fleet of six of the twelve-foot dinghies made in the shop are kept on a nearby pond for racing during the fall and spring. Many students elect this sport as their outdoor activity, and spend two hours every day either racing or on some connected part of the sailing program.

Another example of a boat building program that is recreational in nature, may be observed at Polytechnic Elementary and Junior High School, Pasadena, California. James McGregor, instructor at the school teaches boys to build kayaks, paddle boards, and small boats. Many of his articles on boat building have appeared in various issues of The Industrial Arts and Vocational Education Magazine. McGregor makes this voluntary statement in answering an informal questionnaire presented to him in June, 1942, in connection with the preparation of this thesis.

> Boat building is an excellent type of shop work for schools within reasonable distance of a lake, river, ocean or other suitable place for sailing.

The interest boys have shown in boat building in this city of California, thousands of miles from the state of New Hampshire where a like shop program is in progress, indicates the possibility of a similar reaction in the thousands of cities and town that lie between the coast lines of this United States.

The evolution of boat building, from primative man, to the boys in the schools of America, has been affected by

the geographical location, the wind and weather, and all of the other physical elements present in the existence of the peoples of the world. It is interesting to note that a mere boy, in the present-day school shop with the material modern science has provided him, can build a boat, far superior in workmanship and usability than any produced in the dark ages of the past. A school program should provide an opportunity for the boy in the shop to develop all of his talents to the extent of his ability in order that his life may be lived on a scale of successful achievement comparable to the scientific plane of this age.

The next chapter of this study will be devoted to a discussion of the physical characteristics of Oklahoma that contribute to an ideal school shop program, similar to those reviewed in this chapter that provide and accomplish broad and comprehensive objectives.

CHAPTER III

THE APPROPRIATENESS OF BOAT BUILDING AS AN INDUSTRIAL ARTS SUBJECT IN MANY OKLAHOMA SCHOOLS

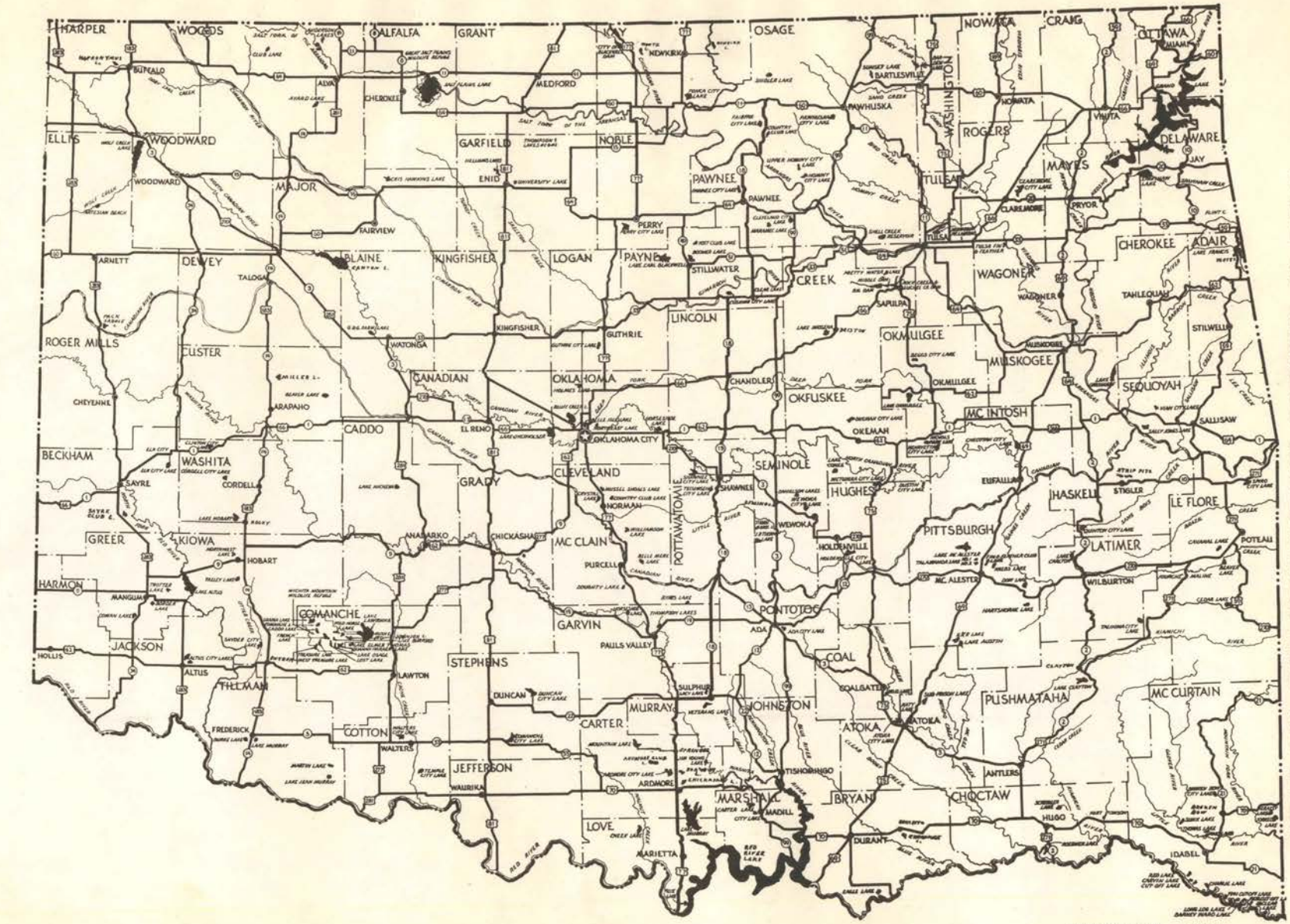
Oklahoma has often been thought of as having a semi-arid climate with almost no surface waterways but many events have occurred during recent years that many change the status of the state from one, famed as the "dust bowl" of America, to that of a recreational area dotted with hundreds of lakes. In addition to the soil conservation program maintained in Oklahoma by the federal government, many flood control measures have been planned and completed in the state which have resulted in the construction of huge dams providing storage space for flood waters. Some of these large man-made lakes also provide a source of water power and practically all are being developed into recreational centers where fishing, boating, and many other water sports are predominant. The lakes are not located in a particular sector of Oklahoma but are evenly distributed throughout the state, thus making it possible for a considerably greater number of people to enjoy them.

WATERWAYS AND AREAS AVAILABLE FOR BOATING IN OKLAHOMA

There are many small streams and several rivers in Oklahoma that provide boating facilities during a part of the year. Especially is this true of the streams in the eastern and southeastern part of the state. The most

important areas for boating, however, are those provided by the construction of dams for purposes of flood control, irrigation, water power, and drinking water supply. There are more than two hundred lakes with an area of more than ten acres, fifteen with more than 1000 acres and the largest which is now under construction by the federal government on Red River having an area of 130,000 acres. The total area that will be covered by the lakes of Oklahoma when all of them are completed is more than 400,000 acres which would be equivalent to the size of a canal one mile wide, extending across the country from McCurtain county, in the Southeast, to Cimarron county, in the Panhandle, a distance of more than five hundred miles.

Configuration of Oklahoma. The highest area in Oklahoma is The Black Mesa, with an altitude of 4,978 feet, located in the Panhandle. Other mountainous regions of the state are: the Wichita Mountains in the southwest-central part, the Arbuckle Mountains in the south-central part, the Kiamichi Mountains in the southeastern part, and the Ozark Mountains in the extreme northeastern corner. The lowest point in Oklahoma is Red River at the southeast corner of the state where it is only 325 feet above sea level. The topography of Oklahoma as just described indicates that the general direction of the flow of the streams of the state is toward the east and southeast which is quite true as an examination of an Oklahoma map will show. This fact accounts



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MAP 1

A MAP OF OKLAHOMA SHOWING MORE THAN 200 LAKES

for the more navigable streams found in that part of Oklahoma as it is there that they reach their greatest size before leaving the state. The more important streams are: Arkansas, Grand or Neosho, Verdigris, Salt Fork, Cimarron, North and South Canadian, Washita, Red, North Fork, and Kiamichi, none of which are used commercially at the present time.

To appreciate the numerous lakes which are located in Oklahoma it will be necessary to examine Map 1 which is a photostatic copy of a map copyrighted in 1942 by Charles J. Brill, editor of The Oklahoma Rocket, Oklahoma City, Oklahoma. As further evidence of the vast territory covered by the lakes of the state, a total may be taken of the areas of the lakes listed in Table 1. This table was prepared from a list by Charles J. Brill; and it gives alphabetically the names of two hundred lakes of Oklahoma together with the county in which they are located and the acres covered by each. An examination of Map 1 will show that the lakes are evenly distributed throughout the state, thus providing access for a greater number of people than would be the case if they were concentrated in any one sector.

TABLE 1

LAKES OF OKLAHOMA COVERING TEN ACRES OR MORE

Name of Lake	Location	Area in Acres
Ada, City	Pontotoc County	25
Altus, City (2)	Jackson County	195
Altus, Lugert	Kiowa County	8,000
Aluma Chulosa	Oklahoma County	60

TABLE I (Continued)

Name of Lake	Location	Area in Acres
Anderson (3)	Woods County	120
Ardmore, City	Carter County	400
Ardmore, Club	Carter County	355
Ardmore Rod & Gun Club	Carter County	25
Artesian Beach	Ellis County	14
Atoka, City	Atoka County	40
Austin	Pittsburgh County	48
Avard	Woods County	55
Bar-Dew	Washington-Osage County	40
Barney Ward	McCurtain County	240
Bar Pits	Woods County	half mile
Beggs City	Okmulgee County	20
Belle Isle	Oklahoma County	75
Belle Mere	Cleveland County	20
Big Dam	Creek County	12 M. shore
Blackwell, Carl	Payne County	3,000
Blackwell, City	Kay County	747
Bluff Creek *	Oklahoma County	3,300
Boren, Mounds City	Creek County	18
Boomer	Payne County	477
Briscoe	Oklahoma County	60
Broadlawn Club	Oklahoma County	12
Broken Bow	McCurtain County	50
Byars	McClain County	115
Canton *	Blaine County	20,000
Cardwell	Coal County	10
Carlton	Latimer County	80
Carter	Marshall County	100
Cavanal	LeFlore County	40
Cedar	Kiowa County	10
Cedar	LeFlore County	100
Charlie	McCurtain County	175
Charlotte	Osage County	75
Checotah	McIntosh County	37
Cheek	Love County	200
Cherokee	Bryan County	20
Chickasaw Club	Carter	45
Claremore City	Rogers County	668
Clayton	Pushmataha County	100
Clear	McCurtain County	250
Clear	Payne County	20
Cleveland, City	Osage County	205
Clinton, City	Washita County	300
Clinton, Country Club	Custer County	10
Coblentz	Haskell County	35
Cohee	Okfuskee County	75

* Lakes under construction

TABLE I (Continued)

Name of Lake	Location	Area in Acres
Comanche	Comanche County	55
Comanche, City	Stephens County	200
Cordell, City	Washita County	18
Crystal	Cleveland County	35
Cushing, City	Payne County	300
Cutoff, 1908	McCurtain County	275
Cutoff, 1941	McCurtain County	200
Danielson	Seminole County	30
Davis (2)	McClain County	50
Doughty	McClain County	20
Dow	Pittsburg County	100
Duncan, City	Stephens County	485
Dustin, City	Hughes County	35
Eagle	Bryan County	35
Elk City, City	Beckham County	80
Elmer Thomas	Comanche County	542
Evans	Oklahoma County	20
Fairfax, City	Osage County	110
Fairfax, Country Club	Osage County	18
Fin and Feather	Pittsburg County	80
Fish Lakes (6)	Comanche County	35
Forked	McCurtain County	100
Francis	Adair County	900
French	Comanche County	47
G. & G. Farm	Blaine County	15
Garvin	McCurtain County	60
Grama	Comanche County	100
Grand	Lake O'the Cherokees Mayes, Delaware, Ottawa	52,000
Grassy	McCurtain County	100
Greenleaf	Muskogee County	900
Guthrie, City	Logan County	200
Hallet	Osage County	15
Hallum	Beckham County	12
Hartley (2)	Craig County	18
Hartshorne, City	Pittsburg County	160
Haskell, City	Muskogee County	30
Hellum's (3)	Garfield County	50
Hieronymus	Harper County	26
Higgins (3)	Osage County	42
Hiawassee	Oklahoma County	160
Henryetta, City	Okmulgee County	500
Hobart, City	Washita County	430
Hobart, N.W.	Kiowa County	20
Holdenville, City	Hughes County	555
Holmes	Oklahoma County	50
Hominy, City	Osage County	50
Horseshoe	Oklahoma County	200
Hugo, City	Choctaw County	24

TABLE I (Continued)

Name of Lake	Location	Area in Acres
Jed Johnson	Comanche County	85
Katy	Atoka County	40
Katy	Seminole County	30
Kiowa Katy Kuntry Klub	Pittsburg County	38
Krebs	Pittsburg County	35
Lacy	Murray County	50
Lawtonka	Comanche County	2,300
Lehigh Strip Pits	Coal County	12
Long Log	McCurtain County	140
Lost	Comanche County	15
Madill, City	Marshall County	60
Mangum Country Club	Greer County	15
Mahoney (3)	Kingfisher County	36
Maramec, City	Pawnee County	55
Marietta Rod & Gun Club	Love County	10
Massena	Creek County	35
McAlester	Pittsburg County	1,800
McGill	Woods County	32
Middle	Creek County	30
Miller	Custer County	36
Mohawk Lagoons	Tulsa County	500
Morris, City	Okmulgee County	30
Mountain	Carter County	400
Murray	Carter County	8,000
Murray	Tillman County	40
Mussel Shoals	Cleveland County	16
Newkirk, City	Kay County	150
Newkirk, Country Club	Kay County	35
Nichols Park	Okmulgee County	20
Northeast	Oklahoma County	30
Okemah	Okfuskee County	171
Okmulgee	Okmulgee County	700
Osage	Comanche County	10
Overholser	Oklahoma-Canadian Counties	2,000
Pack Saddle	Ellis County	10
Papoose	Okfuskee County	70
Parsons	Woods County	32
Pawhuska, City	Osage County	95
Pawnee, City	Pawnee County	300
Perry, City	Noble County	400
Pine	McCurtain County	25
Ponca City	Kay County	1,400
Poteau	LeFlore County	80
Pretty Water	Creek County	35
Pyle	Garvin County	15
Quanah Parker	Comanche County	100
Quinton, City	Haskell County	50
Quinton Country Club	Haskell County	40
Ream	Johnston County	23

TABLE I (Continued)

Name of Lake	Location	Area in Acres
Red River *	Bryan-Marshall Counties	130,000
Rennie (6)	Garvin County	50
Robbs	Rogers County	40
Rock Creek	Creek County	20
Rush	Comanche County	50
Sallisaw Dam	Sequoyah County	Mile
Sally Jones	Sequoyah County	140
Sapulpa Big Dam	Creek County	12 M. shore
Sapulpa Middle Dam	Creek County	20
Sapulpa Country Club	Creek County	40
Salt Plains	Alfalfa County	33,000
Sayre, Club	Beckham County	25
Schooler	Choctaw County	40
Shawnee	Pottawatomie County	2,000
Shell Creek	Osage County	640
Shidler	Osage County	80
Snyder, City	Kiowa County	60
Spavinaw	Mayes County	1,700
Spiro, City	LeFlore County	110
Spring	Creek County	20
Stigler, City	Haskell County	20
Stigler Strip Pits	Haskell County	80
Sub-Prison	Atoka County	60
Sunk	McCurtain County	60
Sunset	Osage County	175
Swallow (4)	Noble County	36
Tabler	Grady County	30
Taft	Muskogee County	53
Talawanda No. 1	Pittsburg County	160
Talawanda No. 2	Pittsburg County	240
Talihina	Latimer County	30
Talley-Ho	Kiowa County	30
Tecumseh	Pottawatomie County	175
Temple	Cotton County	45
Thorn	Seminole County	120
Thorn Brothers	Seminole County	220
Thomas	McCurtain County	542
Tulsa Fin & Feather	Tulsa County	25
Twelve	Coal County	160
Veterans	Murray County	15
Vian, City	Sequoyah County	115
Walters, City	Cotton County	35
Welch	Harmon County	20
Weleetka	Okfuskee County	27
Wetumka	Hughes County	245
Wewoka	Seminole County	480
Whitesboro	LeFlore County	40
Wolf Creek	Woodward County	14,000
Wolfenbarger	Kay County	35

* Lake under construction

TABLE I (Continued)

Name of Lake	Location	Area in Acres
Wright	Oklahoma County	20
Yanubbe	McCurtain County	50
Yost Club	Payne County	38

Most of the larger lakes were built during the past decade under the supervision of agencies of the Federal Government. The dam impounding the waters of the Lake O'the Cherokees was completed in 1939 and it was completely filled in the fall of 1940 but Red River Lake is scheduled to be finished in 1944 and is not open to the public as yet. These two lakes were built primarily as a flood control measure and a power development program, however, they will provide increasing possibilities for the outdoorsman and boating enthusiast. Salt Plains and Carl Blackwell lakes, in addition to being flood control projects, serve mainly as Wild Life Refuges. Salt Plains is closed to sportsmen for the duration of the war but Carl Blackwell is becoming popular for fishing and boating in the central part of the state. Wolf Creek and Canton lakes are being constructed by the Federal Government to control the flood waters of the North Canadian River and they will provide the sports of fishing and boating to many people in the western part of Oklahoma. Lake Altus has been enlarged to provide additional water for irrigation in that area but it and Lake Lawtonka with the smaller lakes of the Wichita Mountain Wild-life Refuge area will provide countless hours of water sports for the inhabitants of Southwestern Oklahoma.

TABLE 2

CITIES OF OKLAHOMA WITHIN TWENTY MILES OF IMPORTANT LAKES

Cities Over 5,000	Population	Lakes 200 Acres or More
Altus	8,593	Altus (Lugert) *
Ardmore	16,886	Murray
		Ardmore, City
		Ardmore, Club
		Mountain
Blackwell	8,537	Blackwell, City
Clinton	6,736	Clinton, City
Cushing	7,703	Cushing, City
Duncan	9,207	Duncan, City
Durant	10,027	Red River *
Elk City	5,201	Clinton
El Reno	10,078	Overholser
Guthrie	10,018	Guthrie, City
		Carl Blackwell
Henryetta	6,905	Henryetta, City
		Okmulgee, City
Holdenville	6,632	Holdenville, City
		Wewoka, City
Hugo	5,909	Roebuck
Lawton	18,055	Lawtonka
		Elmer Thomas
McAlester	12,401	McAlester
		Talawanda No. 2
Miami	8,345	Lake O' The Cherokees
Muskogee	32,332	Greenleaf
Oklahoma City	204,424	Overholser
		Bluff Creek *
		Horseshoe
Okmulgee	16,051	Okmulgee, City
Perry	5,045	Carl Blackwell
		Perry, City
Picher	5,848	Lake O' The Cherokees
Ponca City	16,794	Ponca City, City
Sand Springs	6,137	Shell Creek
		Mohawk Lagoons
Sapulpa	12,249	Shell Creek
Seminole	11,547	Thorn Brothers
		Wewoka, City
Shawnee	22,053	Shawnee, City
		Horseshoe
Stillwater	10,097	Carl Blackwell
		Boomer
Vinita	5,685	Lake O' The Cherokees
Tulsa	142,157	Mohawk Lagoons
		Shell Creek
Wewoka	10,315	Wewoka, City
		Holdenville, City
Woodward	5,406	Wolf Creek

* Lakes under construction

TABLE 3

LAKES OF OKLAHOMA COVERING 200 ACRES OR MORE

Name of Lake	Area in Acres
Red River *	130,000
Lake O' The Cherokees	52,000
Salt Plains	32,000
Canton *	20,000
Wolf Creek	14,000
Murray, Carter County	8,000
Altus, Lugert *	8,000
Bluff Creek *	3,300
Blackwell, Carl	3,000
Lawtonka	2,300
Overholser	2,000
Shawnee, City	2,000
McAlester, City	1,800
Spavinaw	1,700
Ponca City	1,400
Francis	900
Greenleaf	900
Blackwell, City	747
Okmulgee, City	700
Claremore, City	668
Shell Creek	640
Holdenville, City	555
Thomas, Elmer	542
Henryetta, City	500
Mohawk Lagoons	500
Duncan, City	485
Wewoka, City	480
Boomer	477
Hobart, City	430
Ardmore, City	400
Mountain	400
Perry, City	400
Ardmore, City	355
Pawnee, City	300
Clinton, City	300
Cushing, City	300
Cutoff, 1908	275
Clear, McCurtain County	250
Wetumka, City	245
Barney Ward	240
Talawanda No. 2	240
Thorn Brothers	220
Cleveland, City	205
Cheek	200
Comanche, City	200
Cutoff, 1914	200
Guthrie, City	200
Horseshoe	200

* Lakes under construction

Table 3 is a list of the forty-eight lakes of Oklahoma that cover an area of two hundred acres or more. They are arranged in the order of their size, with the number of acres covered by each given. This group of lakes has a combined area of approximately 300,000 acres which is almost three-fourths of the combined area of all the lakes of Oklahoma. All of them are large enough to provide considerable boating activities.

TABLE 4

CLASSIFICATION OF OKLAHOMA LAKES

Number of Lakes	Size Classification in Acres
1	over 100,000
1	50,000 - 100,000
1	2,500 - 50,000
1	1,500 - 25,000
1	1,000 - 15,000
2	5,000 - 10,000
2	2,500 - 5,000
3	2,000 - 2,500
2	1,500 - 2,000
1	1,000 - 1,500
10	500 - 1,000
7	400 - 500
4	300 - 400
12	200 - 300
27	100 - 200
125	10 - 100

The two hundred most important lakes in Oklahoma are grouped and classified according to size in Table 4. It may be noted that the largest lake shown is greater in size than the combined area of the 125 lakes of the smallest classification. In spite of the fact that more than half of the two

hundred lakes in Oklahoma, as indicated in Table 4, are less than one hundred acres in area there are many water ares that are ideally suited to boating, however, these smaller lakes are not ignored by many boat enthusiasts and fishermen.

The numerous lakes of Oklahoma offer many opportunities for those who will need to drive only a few miles, in most cases, to suitable boating area. There are enough large lakes to provide the person who desires an opportunity for a limited amount of cruising experience similar to that in the coastal areas of America. The people of Oklahoma have indicated that they will take advantage of these opportunities for boating pleasure, but for them to enjoy boating to the fullest they should have an understanding of proper boat designs, and many of them will want to build their own boat, therefore, they should be able to secure dependable instruction in the techniques of boat building.

POPULATION CENTERS OF OKLAHOMA HAVING BOATING FACILITIES AVAILABLE

There are several large cities of Oklahoma within easy driving distance of one or more lakes. Tulsa and Oklahoma City have moderate boating facilities and many other smaller cities and towns are near such lakes as Lake O' the Cherokees, Lake Murray, and Red River Lake which is scheduled to be completed in 1944. There are more than 600,000 people, in cities of Oklahoma having a population of 5,000 or more, that live within twenty miles of one or

more lakes covering an area of as much as two hundred acres. Table 2 shows a list of these thirty-one cities together with their population, and the names of the lakes that are within a twenty mile radius of them. This list does not include any of the thousands of persons living in small towns and rural areas that have the same facilities, and it may be estimated that there are more than a million people in Oklahoma who live within twenty miles of at least one lake large enough for extended boating activities.

INTEREST SHOWN IN BOATING BY OKLAHOMANS

During the past ten years an accelerated interest in boating has been evident throughout America and especially is this true of the areas in which new lakes of considerable size have been built. Oklahoma has been among those states to gain thousands of additional acres of water suitable for boating and many people of the state have taken advantage of these new recreational facilities. W. F. Crosby, editor of The Rudder Magazine, makes this statement about the interest Oklahomans have shown in boating. (5, page 36) "Yes, there's more small boat enthusiasm there than in many a coastal state."

There are several conditions which may have had a direct bearing on the increasing interest in boating activities in Oklahoma, among which are the following: an increase of leisure time as a result of shorter working hours, which resulted in many leisure time activities; the construction

of lakes by the federal government that furnished a job for thousands of men and provided a recreational area as well; the interest naval architects have taken in designing small boats that have done much to take the mystery out of boat building, thus, enabling the amateur to build a boat suitable for his needs; the development of small, light-weight, portable motors for outboard use; and the small woodworking machinery available at low prices which has done much to take the drudgery out of home workshop project building. All of these have been instrumental in stimulating boating activities but the recent development of resin glue and waterproof plywood will do much to make it possible for a greater number of people to build their own boat so that they, too, may enjoy the pleasure the waterways afford.

The active participation of so great a number of Oklahomans in boating may be exemplified by the hundreds of boats that may be seen on the highways being transported to one of the many lakes of the state; by the yacht clubs that have been organized at the popular boating centers; by the Sea Scout Ships that have been chartered; and by the establishment of boat manufacturing plants in the state.

Yacht Clubs of Oklahoma. At the present time there are five popular yacht clubs in Oklahoma. Table 5 lists their names, their location, year of organization, and approximate membership.

The information contained in Table 5 clearly indicates that there are relatively few persons who have membership in a yacht club, however, this is not a true representation of the great number of people who own and operate small boats. This list does indicate that enthusiasm for boating in Oklahoma has culminated in organized clubs for the promotion of boating and that, within the last few years, which suggests a definite attempt to utilize the facilities Oklahoma water areas afford. The clubs named in this table are devoted

TABLE 5

YACHT CLUBS OF OKLAHOMA

Name of Club	Location	Membership	Date of Organization
Oklahoma City Yacht Club	Lake Overholser	60	1930
Sooner Yacht Club	Lake Overholser	50	1934
Sequoyah Yacht Club	Mohawk Lagoon	60	1936
Grand River Sailing Club	Grand River	15	1941
Cherokee Yacht Club	Grand River	40	1941

almost entirely to sailing and there is no information available regarding the out-board motor fan, but considerable interest in the speedy out board skimmers is evidenced by the number of them that may be seen on the various lakes of Oklahoma during the summer season.

Sea Scouts of America. No attempt will be made here to list the various Sea Scout Ships of this state but the fact that many Boy Scout Troops have expanded their program to include Sea Scout training is an indication of the demand for water sports and boating activities.

Boat Manufacturers in Oklahoma. As a result of the interest the people of Oklahoma have shown in the past, relative to boating, a few concerns have commercialized this interest and are attempting to meet the growing demands for small boats.

In 1924 Tyler Mill Works, 535 South Kenosha, Tulsa, Oklahoma, started in the production of small boats. Since that time the firm has built hundreds of small boats and many boats suitable for cruising. At one time two train carloads of boats were shipped by this firm to Memphis, Tennessee, for the American Red Cross which used them in the emergency created by the Ohio River flood. Tyler Mill Works has a branch shop at Port Tyler, Disney, Oklahoma, which operates under the name of Tyler Boat Works.

The Ribble Boat Works, 510 West Grand Avenue, Oklahoma City, Oklahoma, was opened for business in 1934 and has built and sold several hundred boats of various types. Their most popular boat is what they call the "Scout" which is a sixteen foot sail boat. It may be seen on many of the various lakes of Oklahoma and especially at Lake Overholser near Oklahoma City.

There are several other small concerns and individuals that do boat building and repair work in a limited way, but specialize in boat sales or motor repair or both. The names of these firms will be given in the following discussion of boat building supplies and equipment.

Boat Building Supplies and Equipment. The individual who is first entering the field of boat building will be at a loss to know where to turn for proper marine supplies. It is very probable that he will turn to the advertising section of the national boating magazines to select a firm from which his needs can be filled. A list of the manufacturers of marine hardware, paint, lumber, fastenings, equipment, stock boats, etc., is given in Chapter V of this thesis, but a part of the remainder of this chapter will consider the supplies and equipment that can be obtained in Oklahoma.

There are numerous concerns in Oklahoma that stock boat paint, marine hardware, life belts and cushions, outboard motors, etc., and there are several firms that are devoted entirely to the boating trade. The names of many of these firms, their location, and the products they distribute are given in the following list.

Avon Supply Co., 123 N.W. Third Street, Oklahoma City, Oklahoma. Dealer and distributor of small boats, outboard motors, marine paint, marine hardware, and boating accessories such as life belts and cushions.

Everett Motor Co., 420 E. Second Avenue, Tulsa, Oklahoma. Carries an extensive stock of small outboard motor boats, outboard motors, marine paint, marine hardware, surf boards, water skis and boating accessories. Operates a repair department for outboard motors.

E. C. Gregg Garage, Enid, Oklahoma. Makes small motor boats and repairs boat motors. Carries a small stock of marine hardware, marine paint, outboard motors, and boating accessories.

Oklahoma City Boat and Motor Co., 25 N. Dewey, Oklahoma City, Oklahoma. Makes small boats and cruisers on order. Carries a stock of outboard motors, a limited stock of marine hardware, and boating accessories.

Ribble Boat Works, 510 W. Grand, Oklahoma City, Oklahoma. Builder of sailboats, motorboats, cruisers, and row boats. Carries a stock of marine hardware, considerable marine paint, and boating accessories.

Spavinaw Sport Shop, Spavinaw, Oklahoma. Carries a limited stock of outboard motors, marine hardware, paint, and boating accessories.

Tyler Cabinet and Mill Works, 535 S. Kenosha, Tulsa, Oklahoma. Builds sailboats, outboard motorboats, cruisers and other types of water craft. Carries a stock of marine accessories. Has a branch shop at Disney, Oklahoma, for boat repair and upkeep.

Zaloudek Implement Co., Enid, Oklahoma. Carries a limited stock of marine paint and accessories. Dealer and distributor of light outboard and inboard motorboats, and outboard motors.

In addition to the firms just listed there are concerns that are able to furnish lumber and plywood suitable for use in boat construction. The name of some of these distributors are given in the next list. All of them are located in Oklahoma except Roddis Lumber Co., but the name of this firm was included here because the business relationship this writer has had with this firm indicates that any material obtained from them is high in quality and more than reasonable in price. The industrial arts teacher can profit by securing their catalogue and price list.

Hannah Hardwood and Plywood Co., 401 S. Peoria, Tulsa, Oklahoma. Carries a stock of air dried lumber suitable for boats, and also stocks a limited supply of waterproof resin-bonded plywood.

Long Bell Lumber Co., 23rd Street, Oklahoma City, Oklahoma. Carries a limited stock of mahogany and other wood suitable for use in boat construction. Also stocks considerable waterproof resin-bonded plywood.

Overhead Door Company of Oklahoma and Arkansas, 1830 N.W. Fifth Street, Oklahoma City, Oklahoma. Carry a considerable stock of spruce which they use in the manufacturing of doors. They also carry special lengths of spruce suitable for sail boat masts and have facilities for gluing long hollow masts up to twenty-eight feet. This firm is probably the only source of spruce in Oklahoma.

Roddis Plywood and Veneer Company, Kansas City, Missouri. Carry an extensive stock of Resnprest resin-bonded plywood in lengths up to and including sixteen feet. Can furnish longer lengths from the M and M Woodworking Company, Portland, Oregon, on special order.

These companies are not by any means all of those that can supply boat building lumber, but this writer can personally recommend them from past experience, and they will provide a suitable source of material until others are required.

Due to the extensive development of the waterways of Oklahoma during the past decade the population centers of Oklahoma have been provided unusual boating facilities. The total area covered by the man-made lakes of the state exceeds 400,000 acres which provides an opportunity for all the people of Oklahoma to enjoy the opportunities they afford. It is estimated that more than a million people live within twenty miles of one or more of the forty-eight lakes covering 200 acres or more. The interest Oklahomans have shown in

boating is evidenced by the organization of yacht clubs, and Sea Scout Ships and further by the establishment of boat building concerns and distributors of marine supplies and equipment.

The next phase of this study will deal with a discussion of the books and periodicals of amateur boat building with an annotation of the current literature available that is applicable to it.

CHAPTER IV

THE LITERATURE OF AMATEUR BOAT BUILDING

Every industry evolves a particular type of literature that is automatically suited to a complete analysis and description of the source from which it originates. The literature of the sea and particularily of boat building is both different and interesting, because the language of the sea is a distinctive one. Books written on boats or boating require the use of terms and expressions that are meaningless to the average layman and they require an understanding before proper appreciation can be accorded.

There have been thousands of books written on the romance of the sea but relatively few have been written that add to man's knowledge of ways and means to conquer the vast expanse of this earth that is covered by water, and still fewer books have been written to enable the layman or amateur to glean any information of value from them. However, during the past decade several books on amateur boat building and related subjects such as navigation and boat designing have been written. These books together with the added interest boating magazines have shown in the desires of the amateur, have done much to take the mystery out of an old industry, the secrets of which have been for generations handed down from father to son.

BOOKS SUITABLE FOR USE AS TEXTBOOKS AND PRIMARY REFERENCES

At the present time there are fewer than twenty American books devoted to discussions of boat building methods and techniques adaptable to the use of amateurs and inexperienced workmen. Practically all of these have been written or revised during the past few years and are up to date in almost every respect. Among these books written for amateurs there are few that can be used as textbooks, only two or three perhaps, the others serving as useful supplementary information on design and construction, and related information such as sail making. Books on how to build particular designs and plan books of boats should not be confused with those dealing with general instructional information. There are numerous volumes of the former and there is little need for a discussion of them in these pages excepting to enumerate the sources from which they may be obtained.

Textbooks Suitable for School Boatbuilding Shops. Sometimes it is very difficult for a teacher to decide on appropriate textbooks for use in the class which is to be taught, however, in the case of choosing a textbook or textbooks for a class in boat building the field is narrowed down to only a few because others have not been written. This is no indication that those books that are available do not contain excellent material; that is far from the truth, many having been written to fill the needs of a public clamoring for definite information on small boat construction.

The following selected bibliography of amateur boat building contains all of the books this writer has been able to find that deal with the fundamentals of boat construction. There are a few English books suitable for use by amateur boat builders and one has been included in the bibliography. Due to the difficulty encountered in obtaining them, this writer has been able to examine only one, Small Sailing Craft by Sutton. Amateur Boat Building and Boatbuilding by Crosby and Chapelle respectively are the two most desirable books for use as texts.

1. Bradford, Gersham, A Glossary of Sea Terms, Dodd, Mead and Company, Inc., New York, 1927, 1942, 217 pages, cost $3.00

2. Chapelle, Howard I., Boatbuilding, W. W. Norton and Company Inc., New York, 1941, 624 pages, cost $5.00

3. Crosby, W. F., Amateur Boat Building, The Rudder Publishing Co., Nine Murray Street, New York, 1938, 235 pages, cost $3.00

4. Hauber, Widd, How to Build Boats, Cleveland Boat Blueprint Co., Cleveland, Ohio, 1941, 87 pages, cost $1.00, paper cover

5. Monk, Edwin, Small Boat Building, Charles Scribner's Sons, New York, 1934, 113 pages, cost $3.00

6. Monk, Edwin, Modern Boat Building, Charles Scribner's Sons, New York, 1939, 103 pages, cost $3.00

7. Patterson, H. W., Small Boat Building, The Macmillan Co., New York, 1929, 144 pages, cost $1.00

8. Sutton, John F., Small Sailing Craft, Pitman Publishing Corp., 2 West 45th Street, New York, 1937, 138 pages, cost $1.75

On the following pages will be found an annotation of the bibliography given above. This is to provide the

prospective boat builder or teacher with enough information on the books available to be able to select the textbooks and references without undue waste of time and effort.

A Glossary of Sea Terms

This glossary by Bradford should be in every school shop library where boat building is carried on. It contains more than five thousand definitions and terms many of which are illustrated so that the beginner or amateur may easily learn the language of the sea. The student who is learning boat construction should be able to learn with ease, the names of the parts he is to build so that his experience can be extended as far as possible.

Boatbuilding

This book by Chapelle is one of the most complete books suitable for use as a textbook, this writer has examined. It was designed as a practical handbook, written to meet the needs of the builder and covers the complete process of wood boat construction. It is particularily beneficial in helping the boat builder overcome many of the discouraging delays resulting from unavailable information on the practical side of boat building. The book is divided into well organized chapters and is well illustrated with almost two hundred drawings and pictures which, together with the well prepared index, add to the merits of the book as a basic textbook.

Amateur Boat Building

This book was written by the editor of The Rudder Magazine who has for many years been in a position to learn and appreciate the problems of the amateur boat builder. The author is the designer of "Snipe", the most popular sail boat in the world, and many other boats suitable for amateur construction. Amateur Boat Building was written for amateur builders and is suitable for use as a textbook in school shops. The language is clear, simple, and understandable, and the book is illustrated with many drawings. The techniques of vee-bottom boat construction is stressed, with very little information being given on other types.

How to Build Boats

This is a paper bound pamphlet written for those who have had little or no experience in boat building. It is simply written and is well illustrated with sixty-nine drawings. The subject matter is divided into short chapters or topics in which most of the fundamentals of boat construction are explained. The cost of the book will be subtracted from the price of any full size blueprints purchased from the Cleveland Blueprint Company.

Small Boat Building

This book is the first of two books written by Monk and is designed for use by the amateur having no previous experience in boat building. In addition to a discussion of boatbuilding woods, materials, fastenings, and finishes, the

problem of beveling frames is well discussed which serves as invaluable help to the amateur who is mostly concerned with vee-bottom construction. This book contains complete plans and building instructions for sixteen small boats of the conventional chine construction and is printed on large nine and one-fourth by twelve and one-half inch sheets many of which are larger and fold in so that more detailed drawings can be made of the larger plans.

Modern Boat Building

This book by Monk, the second of its type by this prominent naval architect of the Pacific Coast, is an excellent new book printed on large sheets, nine by twelve inches, and is well illustrated with recently made drawings and photographs. Although the author deals mostly with the large round-bottom boat, he discusses the vee-bottom boat in a very understandable manner, especially the problem of beveling the frames which is often a troublesome and much neglected phase of boat building. This book will be of most benefit to those who have had some previous boat building experience.

Small Boat Building

This book is mostly concerned with round-bottom boat construction but it contains considerable material on tools and their uses, types and kinds of woods with special reference to the method of sawing and seasoning, laying down the lines, setting up moulds, and framing and planking all of which is useful in constructing any small boat.

Small Sailing Craft

This is an English book that is devoted to the design and construction of small sail boats. It contains more than sixty drawings and photographs which are very helpful in understanding the well organized discussions of methods and materials used in boat building, design of boats, their speed and power, rigs and sails, sail making, and yacht racing. One chapter is devoted to the plans and building instructions of the 16 foot "Sharpie" which is a popular small boat used in English waters.

Supplementary Material

In addition to the annotated bibliography in the preceding pages which will be of great benefit to a teacher selecting books for use as texts in a boat building course; the following list of books, containing supplementary information such as designing and sail making, will be of considerable aid in selecting and obtaining additional references.

1. Boy Scouts of America, The Sea Scout Manual, 2 Park Avenue, New York, 1939, 698 pages, cost $.60, paper cover

2. Chapelle, Howard I., Yacht Designing and Planning, W. W. Norton and Company, Inc., New York, 1936, 319 pages, cost $3.75

3. Davis, Charles G., The A B C of Yacht Design, The Rudder Publishing Co., 9 Murray Street, New York, 1935, 68 pages, cost $1.00, paper cover

4. Desmond, Charles, Naval Architecture Simplified, a Textbook of Small Power Boat Design, The Rudder Publishing Co., 9 Murray Street, New York, 1935, 117 pages, cost $5.00

5. Gray, Alan, Sailmaking Simplified, The Rudder Publishing Co., 9 Murray Street, New York, 1940, 134 pages, cost $2.25

The Sea Scout Manual

This book has more general information on boats and boating than any other obtainable at such a low price. It does not contain much information on how to build boats, except for a chapter on how to build a ten-foot row boat. However, the book is profusely illustrated with photographs and drawings which is an aid to the discussion of types of boats, history of boats, and their general care and operation. Those who have a love of boating will want a copy of The Sea Scout Manual.

Yacht Designing and Planning

This book, by a well known professional architect, is invaluable to the boat builder whether he be an amateur or a commercial producer. It will be of considerable help in making a choice of the proper design of boat for any specific purpose. A discussion of the materials suitable for boats, use and types of tools, and standard professional methods of joiner and layout work is given, which add to the value of the book for use in a school shop. Techniques of yacht designing and planning are explained in a very understandable fashion and should be of interest to boat builders although being of little practical value in actual boat construction.

The A B C of Yacht Design

This little paper bound booklet was written for those who wish to design and understand boats simply for the fun of it and was not intended for use by professionals. The

author discusses how the shape of a boat's lines are developed, and the difference of opinion among naval architects as to the best style, shape, and design. The importance of choosing a suitable design of boat for the intended purpose is emphasized. Some of the complicated calculations used by boat designers are explained in a manner understandable to the amateur. For example, Simpson's rule, a system of calculating displacement, and area of curved figures are given in such a way that little technical information is necessary in mastering the procedure.

Naval Architecture Simplified

This work is a textbook of small power boat design, printed on large sheets, nine by twelve and one-fourth inches. It is written in simple manner but the amateur may have some difficulty in understanding all of the principles of the calculations explained, however, the many illustrations and tables are of considerable benefit and much information on the fundamental theories of boat design can be obtained by the unskilled.

Sailmaking Simplified

This book may be classed as a sailmaker's manual. It was written for the benefit of those who wish to make their own sails; and is the only book devoted to sailmaking available to the layman since sailmakers of past generations as well as the present have kept their knowledge of the trade as much to themselves as possible. The types of cloth best

suited to sailmaking and all types of small sails are explained in a simple manner that can be followed by most amateurs without having had previous experience in the art. The book is well illustrated with ninety photographs and drawings which serve to simplify the discussion to a considerable extent.

The books discussed in the preceding pages have been written for a very critical public whose insistent demands for the information have resulted in their publication. The books are of recent publication, many having been written first as a series of magazine articles, and because of popular demand, have been published in book form. All of them can be obtained from The Rudder Publishing Company, 9 Murray Street, New York, except How To Build Boats by Widd Hauber, which may be secured only from the publisher.

The recency of the above publications indicate a growing interest by the general public in boats and their construction and this interest is being exemplified by the popularity accorded the current periodicals devoted to boating activities.

PERIODICALS DEVOTED ENTIRELY OR IN PART TO BOAT BUILDING

There are several current publications which are devoted entirely to the boating industry and they are specialists in their field, dependable in the advice and recommendations they may give to their public, because that is their

business. On the other hand, many other publications publish occasional plans or information related to boats and their construction and some of it may not be practical. It is doubtful if an all-inclusive magazine can be expected to include authentic information about all the industries it attempts to represent. The individual who seeks current information about boats can best be assured of satisfaction if he depends on periodicals devoted entirely to that field.

Periodicals Devoted Exclusively to Boat Building and Boating. There are only four periodicals, devoted entirely to boats and their use, that have come to the attention of this writer. Most of them can be obtained only by a subscription as they are not sold at any but the largest news stands. The following is a list of the periodicals:

1. Motorboat combined with Power Boating, Motor Boat Publications Inc., 63 Beekman Street, New York, monthly, $2.00
2. Motor Boating, Hearst Magazines, Inc., 572 Madison Avenue, New York, monthly, $3.00
3. The Rudder Magazine, Rudder Publishing Co., 9 Murray Street, New York, monthly, $3.00
4. Yachting Magazine, Yachting Publishing Corporation, 205 East 42nd St., New York, monthly, $4.00

Motorboat is a popular magazine with the motor boat sportsman. It is devoted to information dealing with congressional action related to the boating world, true stories of cruising, technical information on boat designing and planning, practical discussions of interest to every boatman,

and building plans of various types of boats suitable for construction by amateurs. Although this magazine does not command a universal appeal, it contains much valuable information and many suggestions of interest to boat builders.

Motor Boating is an excellent boating magazine for those who are interested in large and small ocean going boats. As the name indicates, motor boats are considered mostly, however, considerable information is given on sailing boats, and occasional plans for building small boats are printed.

The Rudder Magazine has been published for more than half a century and should prove to be most beneficial to those who are interested in small boats and how to build them. There are several "How to Build" articles published every year of various types and sizes of boats suitable for amateur construction. These articles and designs are produced by reputable naval architects who are specialists in their field. W. F. Crosby, editor of the magazine, has found time to design many small boats especially for amateur construction. One of the most popular boats in the world, the Snipe which is a small racing sloop, was designed by him, and the plans were published in the July issue of this magazine in 1931. It is estimated that eight thousand of these boats have been built and more than half of them by amateurs. In addition to the "How to Build" articles there are numerous true accounts of sea voyages and information on sailing and cruising which

add to the background of information desired by all boat enthusiasts.

Yachting is written to appeal to owners of large boats, and professional builders. Various articles on certain phases of boating are published but many are more or less technical in nature and would be of little practical aid to the amateur sailor or boat builder, but occasionally small boat plans are published.

The periodicals discussed in the preceding pages are reliable sources of information regarding the construction and operation of modern boats. The amateur, as well as the professional builder, should depend on them for the current type of instruction that he demands. There are many other magazines that publish attractive articles on the construction and operation of boats but the amateur has insufficient experience to enable him to analyze the various plans he may observe, therefore, he should rely on that source of information which is backed by persons of wide professional experience such as those contributing to the various current publications devoted exclusively to boating.

Periodicals That Contain Occasional Plans and Articles On Boat Building. There are numerous periodicals that occasionally publish boat designs and various articles on boats and their operation. Some of them are very worth while,

but on the other hand many are questionable and some are distinctly unprofessional.

It cannot be said that plans of boats and other information related to boating which is sometimes published in the various home-mechanics type magazines is not reliable, because many of the contributators are well known naval architects. However, some of the information is not practical for use by amateurs who may not fully understand all of the complications involved. In regard to the use of this source of information, Tyler, Tyler Mill Works, Tulsa, Oklahoma, who has been a builder of boats since 1920, makes this statement, "The home-mechanics variety of boat building plans and designs have done more to discourage amateur boat building than anything else." Mr. Tyler suggests as the basis for the preceding statement that many of the plans submitted by these magazines are not in accordance with those of professional builders, therefore, the amateur is discouraged long before he finishes his boat and even upon completion he discovers that it does not perform as he had expected.

With due regard to all of these who may publish information of value to the fast growing amateur boat building field, this writer feels that this chapter should contain a list of those periodicals which occasionally publish information regarding it. Seven of these magazines are included in the following list.

1. Industrial Arts and Vocational Education, Bruce Publishing Co., Milwaukee, Wisconsin, monthly, $2.50

2. The Home Craftsman, Home Craftsman Publishing Corporation, 115 Worth Street, New York, Bi-monthly, $1.25

3. Mechanix Illustrated, Fawcett Publications, Inc., 1501 Broadway, New York, monthly, $1.00

4. Popular Home Craft, General Publishing Co., 919 North Michigan Avenue, Chicago, Ill., Bi-monthly, $2.00

5. Popular Mechanics Magazine, Popular Mechanics Company, 210 East Ontario Street, Chicago, Ill., monthly, $2.50

6. Popular Science Monthly, Popular Science Publishing Co., Inc., 353 Fourth Avenue, New York, monthly, $1.50

7. Science and Mechanics, 800 North Clark Street, Chicago, Ill., Bi-monthly, $1.00 for 12 issues

By referring to the Industrial Arts Index for the year 1940 in which all of these periodicals are indexed, boat building articles may be found. This represents an average of the articles on boat building per year in the "home mechanics" type magazine.

PUBLISHERS AND DESIGNERS FROM WHOM BOAT PLANS MAY BE OBTAINED

There are two general classifications of boat plans available to professional as well as amateur builders. These are stock plans and custom designs. Stock plans are procurable from various publishers of books on boatbuilding and from naval architects. They are relatively cheap, ranging in price from twenty-five cents or less, to possibly $25.00. Some plans that are distributed by various lumber concerns are free upon request. Especially is this true of recent

designs incorporating the use of waterproof plywood. Custom designs are available from naval architects and designing concerns that design boats and ships. A custom design is relatively high in price because it has probably been laid out to be used in the construction of only one boat. A custom design is usually made at the request of a prospective yacht owner who may intend to spend as much as $50,000 or more for the construction of a large boat and expects at least ten percent of this amount to be required in the payment of the naval architect who will work out all the details of the design and construction. The amateur builder who expects to spend less than a hundred dollars for material in the construction of his boat will not be interested in a custom design because of added expense which would, in all probability, be double the amount necessary for materials. Therefore, in a discussion of the sources from which boat plans are available, this chapter is limited to that field of stock plans which are within the means of the amateur.

Of the firms listed below The Rudder Publishing Company and Hearst Magazines, Inc., are the only publishers of periodicals devoted entirely to boating. Some of the other firms are devoted only to the production of designs while others publish occasional booklets dealing with boat building. The importance of selecting a suitable design cannot be stressed too heavily and the amateur is cautioned to be careful to secure a reputable, tested plan.

1. Boy Scouts of America, National Sea Scout Service, 2 Park Avenue, New York
2. Boy Scouts of America, St. Louis Council, St. Louis, Missouri
3. Brooks Boat Co., Dept. Dl, Saginaw, Michigan, (free catalogue of plans)
4. Cleveland Boat Blueprint Co., Station A., Cleveland, Ohio, (free catalogue of plans)
5. Douglas Fir Plywood Association, Tacoma, Washington, (free plans of plywood boats)
6. Fawcett Publications, Inc., 1501 Broadway, New York, (free catalogue of plans)
7. Harbor Plywood Corporation, Hoquiam, Washington, (free literature and plans of plywood boats)
8. Hearst Magazines, Inc., 572 Madison Avenue, New York, (free catalogue of plans)
9. The Home Craftsman Publishing Corporation, 115 North Street, New York, (free descriptive literature)
10. MacGregor, Charles G. of the firm of Belmont and Paine, 185 Devonshire Street, Boston, Mass.
11. Popular Mechanics Company, 210 East Ontario Street, Chicago, Ill., (free catalogue of plans)
12. Popular Science Publishing Company, Inc., 353 Fourth Avenue, New York, (free catalogue of plans)
13. The Rudder Publishing Company, 9 Murray Street, New York, (free catalogue of plans)
14. Westlawn Associates, Naval Architects, Montville, N. J.

As may be observed from the preceding list, many of the plans are free and most of the concerns have prepared a catalogue of the plans they have available which is free upon request. Other firms will supply the inquirer with information regarding particular types of boat plans in stock.

COMMERCIAL PUBLICATIONS

The amateur boat builder can secure much reliable information regarding popular boats and their specifications, from commercial manufacturers of boats and manufacturers of marine hardware and equipment. Most of these firms will furnish free upon request a catalogue of their product, and many of them have prepared pamphlets of the various phases of the use and maintenance of boats which can be obtained without charge, or at the most, only a few cents to cover postage.

Sources of Materials and Supplies. To assist the amateur boat builder or the teacher of boat building the following lists have been prepared to expedite the securing of information without undue waste of time. Most of these lists have been taken from various issues of The Rudder Magazine.

Informational Pamphlets. Many manufacturers of boats or equipment have prepared pamphlets which are available at small cost, that will add to the value of any school or private library. These pamphlets deal with discussions of boat operation, painting, and upkeep and are designed to provide general information regarding the field of their producers.

A List of Manufacturers of Standard and Stock Boats

Donald B. Abbot, 307 E. 44th St., New York, N. Y.

The Anchorage, Inc., Warren, Rhode Island

A List of Manufacturers of Standard and Stock Boats (Cont'd)

Bay City Boats, Inc., Bay City, Michigan

Carl N. Beetle, 70 Prospect St., New Bedford, Mass.

Brooks Boat Company, 2200 S. Hamilton St., Saginaw, Michigan

Burger Boat Co., Manitowoc, Wisconsin

Cape Cod Shipbuilding Co., Wareham, Mass.

Casey Boat Building Co., Inc., Fairhaven, Mass.

Century Boat Co., Manistee, Michigan

Chris-Craft Corp., Algonac, Michigan

Consolidated Shipbuilding Corp., Morris Heights, New York

Dawn Cruisers, Inc., Ft. of Patterson Ave., Clason Point, Bronx, New York City

Delta Manufacturing Co., 105-43 Ditmars Ave., Corona, N.Y.

Bilbert Dunham, Inc., Shippan Point, Stamford, Conn.

Dunphy Boat Corp., Broad at Parkway, Oshkosh, Wisconsin

Electric Boat Company, Elco Yacht Division, Bayonne, N. J.

Fairform Flyer--Huckins Yacht Corp., 600 East 4th St., Jacksonville, Florida

Fisher Boat Works, Inc., 9666 E. Jefferson Ave., Detroit, Michigan

Gar Wood Industries, Inc., Boat Division, River Road, Marysville, Michigan

Gordon Douglas Boat Co., Vermillion, Ohio

Hacker Boat Company, Judge and Riverview St., Mt. Clemens, Michigan

Hilbilt Boats, Madison, Ind.

The Everett Hunter Boat Co., McHenry, Ill.

Fred Jacoby Boat Works, 8708--40th Street, North Bergen, N.J.

Hubert S. Johnson Boat & Engine Works, Bay Head, N. J.

Keystone Boat Works, Ft. South 7th St., Darby, Pennsylvania

A List of Manufacturers of Standard and Stock Boats (Cont'd)

Lyman Boat Works, Sandusky, Ohio

The Matthews Co., 306 Bayside, Port Clinton, Ohio

New England Marine Company, 305 Congress St., Boston, Mass.

Old Town Canoe Co., Old Town, Maine

Owens Yacht Co., Dundalk, Baltimore, Md.

Pembroke Huckins Co., Foot of Forest St., Jacksonville, Fla.

Penn Yan Boats, Inc., Penn Yan, N. Y.

Pine Castle Boat & Construction Co., Pine Castle, Fla.

Red Bank Marine Wks., Red Bank, N. J.

Richardson Boat Co., Inc., Sweeney, North Tonawanda, N.Y.

Sandusky Boat Works, Washington & Meigs Sts., Sandusky, Ohio

Seaman Sea-Skiffs, 491 Atlantic Ave., Long Branch, N. J.

Skaneateles Boats, Inc., Skaneateles, N. Y.

Sturdy Craft, 1657 Meadow St., Philadelphia, Pa.

Sunflower Boat Works, Lake Tomahawk, Wis.

Thompson Bros. Boat Mfg. Co., Peshtigo, Wisconsin and Cortland, N. Y.

Ventmor Boat Works, Inc., New Ventnor, Atlantic City, N. J.

Wagemaker Company, Grand Rapids, Mich.

Wheeler Shipyard, Inc., Food of Cropsey Ave., Brooklyn, N. Y.

Whittier & Low, Cap Ann Boats, Ipswich, Mass.

Ralph H. Wiley, Osford, Maryland

List of Manufacturers of Marine Hardware, Equipment, and Materials

Fabricated Frames and Boat Parts

Bay City Boats, Inc., 1468 Adams St., Bay City, Michigan
Brooks Boat Co., 2200 So. Hamilton St., Saginaw, Michigan
Delta Mfg. Co., 105-43 Ditmars Ave., Corona, L.I., N.Y.
Laird Boat Wks., 3203 Lafayette Blvd., Norfolk, Va.

Fastenings

American Brass Co., 414 Meadow St., Waterbury, Conn.
American Screw Co., 21 Stevens St., Providence, R. I.
Atlas Tack Corp., 79 Pleasant St., Fairhaven, Mass.
Continental Screw Co., New Bedford, Mass.
H. M. Harper Co., 2634 Bletcher St., Chicago, Ill.
International Nickel Co., Inc., 67 Wall St., New York
Reed & Prince Mfg. Co., 1 Duncan St., Worcester, Mass.
Wilcox, Crittenden & Co., Inc., 120 So. Main St., Middletown, Conn.

Fillers (Deck and Seam)

A. S. Boyle Co., 1934 Dana Ave., Cincinnati, Ohio
L. W. Ferdinand & Co., Inc., 599 Albany St., Boston, Mass.
H. B. Fred Kuhls, 6415 Third Ave., Brooklyn, N. Y.
Stay-Tite Products Co., 3107 Detroit Ave., Brooklyn, N. Y.

Glues, Cement, Etc.

Casein Co. of America, 350 Madison Ave., New York
Dolpin Paint & Varnish Co., Toledo, Ohio
L. W. Ferdinand & Co., Inc., 599 Albany St., Boston, Mass.
The Flexeal Co., Inc., 130 Water St., New York, N. Y.
H. B. Fred Kuls, 6415 Third Ave., Brooklyn, N. Y.

Glue (Resinous for Plywood)

Casein Co. of America, 350 Madison Ave., New York
L. W. Ferdinand & Co., 599 Albany St., Boston, Mass.
United States Plywood Corp., 616 W. 46 St., New York City

Hardware (General Line)

Attwood Brass Wks., 742 Front Ave., Grand Rapids, Michigan
E. S. Burman & Co., 3047 N. Western Ave., Chicago, Ill.
Dayton Mfg. Co., 2240 E. Third St., Dayton, Ohio
Durkee Mfg. Co., 2055 Clove Rd., Grasmere, Staten Island, New York
Hubbard's South Coast Co., 2206 E. Central, Newport Beach, California
Kainer & Co., 763 Lexington St., Chicago, Ill.
Kilborn-Sauer Co., Post Road, Fairfield, Conn.
The Thomas Laughlin Co., 143 Fore St., Portland, Maine
Merriman Bros., Inc., 185 Amory St., Boston, Mass.
Perkins Marine Lamp & Hardware Corp., 1943 Pitkin Ave., Brooklyn, N. Y.
Rostand Mfg. Co., Post Road, Fairfield, Conn.
Wilcox, Crittenden & Co., Inc., 120 So. Main St., Middletown, Conn.
E. J. Willis Co., 91 Chambers St., New York, N. Y.

Marine Hardware Dealers

Armstrong & Galbraith, Inc., 625 Sixth Ave., New York, N. Y.
James Bliss & Co., Inc., 220 State St., Boston, Mass.
The Durkee Co., Inc., 29 South St., New York, N. Y.
Guptill Corp., 175 Commercial St., Portland, Maine
E. C. Hartlieb & Co., 326 Main St., Cincinnati, Ohio
Manhattan Marine & Electric Co., 116 Chambers St., New York
Marine Equipment & Supply Co., Inc., 116-118 Walnut St., Philadelphia, Pa.
Henry H. Smith & Co., 338 E. Jefferson, Detroit, Michigan
W. & J. Tiebout, 118 Chambers St., New York
Topping Bros., 159 Varick St., New York

Lumber

Black & Yates, Inc., 157 Varick Ave., Brooklyn, N. Y.
City Island Lumber & Supply Co., 362 City Island Ave., City Island, New York
Cross, Austin & Ireland Lumber Co., 1246 Grand St., Brooklyn, New York
A. C. Dutton Lumber Corp., Ft. of New York Ave., Providence, Rhode Island
Elson Lumber Co., Inc., 217 W. 21st St., New York, N. Y.
G. D. Emery Co., 220 Eleventh Ave., New York, N. Y.
Hudson Valley Lumber Co., Nanuet, N. Y.
Indiana Mahogany Co., Vernon Blvd. and Fifieth Ave., Long Island City, New York
Kells Mill & Lumber Co., Inc., Java and Provost St., Brooklyn, New York
Geo. McQuesten Co., 27 Kilby St., Boston, Mass.

Lumber (Cont'd)

Frank Paxton Lumber Co., 45 Kansas Ave., Kansas City, Kansas
Yards in Fort Worth, Texas, Denver, Colorado, Des Moines, Iowa
C. H. Pearson & Son Hardware Co., Inc., 98 21st St., Brooklyn, N. Y.
Philippine Mahogany Mfgs. Import Assn., Inc., 111 West Seventh St., Los Angeles, California
Seattle Cedar Lumber Mfg. Co., Seattle, Washington
E. J. Stanton & Son, 2050 E. 41 St., Los Angeles, California
Ichabod T. Williams & Sons, 220 Eleventh Ave., New York
Henry J. Winde Co., 295 Medford St., Charlestown, Mass.
William Wunsch & Son, Englewood Cliffs, N. J.

Metals

Aluminum Co. of America, Gulf Bldg., Pittsburgh, Pennsylvania
American Brass Co., 414 Meadow St., Waterbury, Conn.
American Smelting & Refining Co., 120 Broadway, New York
Chase Brass & Copper Co., Inc., Waterbury, Conn.
T. E. Conklin Brass & Copper Co., Inc., 54-60 Lafayette St., New York
General Alloys Co., 367-405 1st St., Boston, Mass.
International Nickel Co., 67 Wall St., New York
Revere Copper & Brass, Inc., 230 Park Ave., New York

Paints and Varnishes

Bakelite Corp., 30 E. 42 St., New York, N. Y.
Baltimore Copper Paint Co., Key Highway, Baltimore, Md.
Berry Bros., 211 Lieb St., Detroit, Michigan
The Billings-Chapin Co., E. 40 St., Cleveland, Ohio
Bridgeport Bronze Marine Paint Co., Milford, Conn.
Boston Varnish Co., 52 Everett Sta., Boston, Mass.
Brooklyn Varnish Mfg. Co., Inc., 35 Nostrand Ave., Brooklyn, New York
Commerce Varnish Co., 28 Commerce St., Brooklyn, N. Y.
The H. B. Davis Co., Bayard & Severn Sts., Baltimore, Md.
Devoe & Raynolds Co., Inc., 44 St. & 1st Ave., New York City
Dolphin Paint & Varnish Co., Toledo, Ohio
E. I. duPont de Nemours & Co., Inc., Finishes Div., 10th and Market Sts., Wilmington, Delaware
Gillespie Varnish Co., 131 Dey St., Jersey City, N. Y.
International Paint Co., Inc., 21 West St., New York
Oliver Johnson & Co., Inc., 169 Richmond St., Providence, Rhode Island
John W. Masury & Son, 42-50 Jay St., Brooklyn, N. Y.
Metallic Coatings Corp., 234 West 44th St., New York
McCloskey Varnish Co., 7600 State Road, Philadelphia, Pa.

Paints and Varnishes (Cont'd)

New Jersey Paint Wks., 500 Grand St., Jersey City, N. J.
Norfold Paint & Varnish Co., Norfold Downs, Mass.
Pettit Paint Co., Inc., 507 Main St., Belleville, N. J.
F. O. Pierce Co., 30 Tiffany Place, Brooklyn, N. Y.
Pittsburgh Plate Glass Co., Paint Div., Pittsburgh, Pa.
Red Hand Compositions Co., Inc., 1 Broadway, New York
Edw. Smith & Co., 11 E. 36 St., New York
Stearns-McKay Mfg. Co., Marblehead, Mass.
Tarr & Wonson, Ltd., Horton St., Gloucester, Mass.
Valentine & Co., Inc., 11 E. 36 St., New York
Westcott, Slade & Balcom Co., Providence, R. I.
Geo. D. Wetherill & Co., Inc., 113 Arch St., Philadelphia, Pennsylvania
C. A. Woolset Paint & Color Co., 500 Grand St., Jersey City, N. J.

Plywood (Waterproof)

Harbor Plywood Corp., Hoquiam, Washington
Haskelite Mfg. Co., 208 W. Washington St., Chicago, Ill.
Ipik Plywood Corp., 1933 Canal Building, New Orleans, La.
M. & M. Woodworking Co., 2301 N. Columbia Blvd., Portland, Ore.
United States Plywood Corp., 616 W. 46 St., New York

Rope

American Mfg. Co., Noble & West Sts., Brooklyn, N. Y.
Columbian Rope Co., 312-90 Genesee St., Auburn, N. Y.
Edwin H. Fitler Co., 5625 Tacony St., Philadelphia, Pa.
Lambeth Rope Corp., P. O. Box 760, New Bedford, Mass.
New Bedford Cordage Co., 233 Broadway, New York
Plymouth Cordage Co., North Plymouth, Mass.
Rinek Cordage Co., Easton, Pennsylvania
Rochester Ropes, Inc., 91-30 Van Wyck Blvd., Jamaica, N. Y.
Wall Rope Wks., 48 South St., New York
Whitlock Cordage Co., 46 South St., New York

Rope (Wire)

American Chain & Cable Co., Inc., 230 Park Ave., New York
American Steel & Wire Co., Rockefeller Bldg., Cleveland, Ohio
Hazard Wire Rope Div., American Chain & Cable Co., Inc., 230 Park Ave., New York
Phosphor Bronze Smelting Co., 2216 Washington Ave., Philadelphia, Pa.
John A. Roeblings' Sons Co., 107 Liberty St., New York

Sail Cloth

Geo. B. Carpenter and Co., 430-440 N. Wells St., Chicago, Ill.
De Grauw, Aymar & Co., 34-35 South St., New York
Howe & Bainbridge, 220 Commercial St., Boston, Mass.
Chas. P. McClellan, 22 Boomer St., Fall River, Mass.
Wamsutta Mills, Wamsutta St., New Bedford, Mass.

Stainless Steel Fittings

General Alloys Co., 367-405 W. First St., Boston, Mass.
Hazard Wire Rope Div., American Chain & Cable Co., Inc.,
230 Park Ave., New York
Merriman Bros., Inc., 185 Amory St., Boston, Mass.
The Pressed Steel Co., Wilkes-Barre, Pa.

This chapter has been devoted to a discussion of the books devoted to amateur boat building and the periodicals devoted entirely to boating or in part to it. A list of the various producers and distributors of boats and marine equipment has been included to enable the individual to secure other related information in this field. Emphasis has been placed on the importance of securing reliable information regarding boat designs and boat operations to prevent the discouraging experiences encountered by many amateurs.

An examination of the material listed above may serve as a basis in choosing a type of boat for an intended purpose, and the following chapter is devoted to a discussion of a type of boat suitable for amateur construction and use in Oklahoma.

CHAPTER V

A TYPE OF BOAT SUITABLE FOR CONSTRUCTION IN OKLAHOMA SCHOOL SHOPS

Boats and ships for use on inland waterways and on the high seas of the world are built in many designs and sizes, all of which require a particular material suited to the various requirements. Naval vessels, ships built for inter-continental passenger and freight service, craft used for commercial traffic on inland lakes and rivers, and pleasure boats of all classes for salt water or fresh, require appropriate types of construction depending upon their use.

Many industries that depend on the sea have developed types of boats suited to their particular demands and uses. The United States Navy has put into use battleships, destroyers, cruisers, and most recently, the motor torpedo boat which was developed to fill a need for a fast boat that could carry the war to the enemy. It will be appreciated that boats used for pleasure purposes on the many inland lakes of America will require different construction techniques than that used in fast ocean going torpedo boats. During recent years a new product has been developed that permits a greater fulfillment of the different requirements demanded by boat users. This new product is waterproof plywood and this chapter includes an examination of this new material

from a standpoint of the commercial boat manufacturer and the amateur boat builder who have already shown a marked interest in the possibilities claimed for it. The ease and speed with which waterproof plywood can be used may indicate its possible acceptance by industrial arts teachers for a boat building program in many of the school shops of Oklahoma.

TYPES OF BOAT DESIGN

Many arguments for a particular boat design have been propounded by adherents of the various boat classes, and others who may or may not have followed the sea, but whatever may be their convictions the fact remains that there are only three basic designs applicable to boats: flat-bottom, vee-bottom, and round-bottom. The best type of boat is that design that fulfills the requirements demanded of it, which are as numerous and varied as the people who may use them.

The Flat-Bottom Boat. As the name implies, this type of boat has a flat bottom, that is, the bottom has straight sections from side to side. This does not mean, however, that the bottom is straight in a fore and aft direction. Chapelle makes the following observations on the fore and aft outline. (2,page 30)

> ...In sharp-bowed craft, the line of the bottom, viewed in profile, should conform to a general rule. The heel of the stem should either touch

> the water or be just clear of it. From this point the line of bottom, or chine, should run straight and sloping downward for about one third the water-line length of the boat; from there it should go in a reasonably gentle curve through the middle third, and then should again become straight, or very nearly so, and run upward to the stern..... Much of the prejudice against flat-bottom dinghies can be traced to the neglect of this matter on the part of their designers and builders; if there is curvature in the forward third of the chine, in profile, the boat will row heavily.

If these points had been considered by boat builders and designers, many boats in use today would not be considered such a liability by their owners, and would provide more and better boating enjoyments for those who use them.

The flat-bottom boat is primarily a shoal draft type and is used extensively along the coastal area of America as well as on the numerous rivers and inland lakes. It is capable of carrying heavy loads without the corresponding deep draft ratio common in boats of a different design. Flat-bottom boats are easy to make which accounts for the fact that this type is often chosen by the amateur because of its simplicity. The construction difficulties will not offer any great obstacle to the average high school boy having reasonable skill in the use of wood working tools.

Flat-bottom boats may be built in sizes ranging from the smallest pram dinghy to large ocean-going fishing boats sometimes exceeding fifty feet in length. Waterproof plywood may be used in their construction due to the extreme simplicity of the lines, with a definite saving of time in building. This type boat may be rowed, fitted with a sail,

or motor power with good results, however, for seaworthy sailing boats, or motor driven boats of considerable size, other types offer greater advantages.

The Vee-Bottom Boat. This type of boat design is similar in many respects to the flat-bottom, except, the bottom in cross section has more or less vee, known as deadrise. There are many variations in the amount of deadrise of various boats of this type, some of them having what is known as multi-chine construction which approaches the general shape of the round-bottom, but they all incorporate the same fundamental features of construction as the flat-bottom boat.

The vee-bottom type can be used in a heavy sea with safety since much of the strain from pounding by the waves, common in a flat-bottom, is absent in the vee-bottom which tends to ward off the waves and push through them. This type boat can carry a greater load without a corresponding increase in the driving power.

The almost universal acceptance of the vee-bottom boat for construction by amateur builders is a good indication that it is a type easy to build and desirable to use. Waterproof plywood may be used in the construction of vee-bottom boats, however, all vee-bottom designs cannot be planked with plywood. They should be designed especially for this material since compound curves cannot be covered with a single sheet and many boats have a concave flare on

their topsides and possibly in the bottom sections as well. There are many satisfactory designs of sailboats and motor boats suitable for plywood construction.

The Round-Bottom Boat. This type of boat design suggests a round bottom, however, it does not mean that outlines of the cross sections are segments of perfect circles. The bottom is usually flat or has a vee section which joins the side in a smooth curve without the corner found at the chines of the flat or vee-bottom boats. The round-bottom boat is generally accepted for general use no matter what the demand, whether it be on the sea or on a small lake, however, the problems of its construction are different from that of the other two types mentioned. The expense of preparing a building form on which to construct a round-bottom boat is enough to discourage the average amateur builder, while on the other hand a commercial manufacturer may be able to build hundreds of boats on one form resulting in a considerable saving for him in time, and perhaps material. Waterproof plywood cannot be used in the hull of a round-bottom boat, it must be planked in long strips of wood of various widths not exceeding six inches perhaps, in one of the following methods: carvel, lap strake, or strip.

Types of Boats Compared. A comparison of boats in use today may help the individual to arrive at a conclusion as to the type he wants to build or use, as the case may be.

The flat bottom boat is ideal for carrying heavy loads in shallow water and if properly designed provides a seaworthy boat easy to handle. It is the cheapest and easiest type to build, especially from the standpoint of the amateur who may be a boy who is building his first water craft. Under certain conditions the flat-bottom boat is more efficient than other types while under sail, but does not have this same quality under all demands, such as a light breeze or a heavy sea with waves pounding the hull.

The vee-bottom type meets the requirements demanded of a hull that will be seaworthy under all conditions, while at the same time being easy to build. Because of the ease and cheapness in building vee-bottom boats, this type has become one of the most popular in America, especially for the amateur. Crosby, writing of the three general types of boats makes this statement. (3, page 1) "Of the three, the vee-bottom is by far the most popular with amateur builders. It gives much the same effect as the round-bottom boat without the homeliness of the flat-bottom job." Crosby compares the popularity of the vee-bottom with the round-bottom from a standpoint of the amateur builder in the following statements. (4, page vii)

> ...Professionals and some few amateurs will argue that the round-bottom boat is easier and cheaper to build but the proof of the situation is that out of some sixty odd designs available, the vee-bottom boats are built on a ratio of better than one hundred to one by amateurs. There is absolutely no question of this.

It may be concluded from the foregoing that a vee-bottom boat is worthy of consideration by the amateur who is contemplating building his own boat, or by the industrial arts teacher who may be required to decide a type of boat suitable for construction by school pupils.

The round-bottom type offers practically all of the advantages desired in a boat but its construction introduces many problems that are perhaps beyond the scope of the amateur builder or high school class. Monk makes this statement concerning the construction of round-bottom boats. (9, page 1) "This construction is considered a bit difficult for the amateur, although the professional boatbuilder generally considers the round-bottom construction as easier." The round-bottom boat probably is easier to build when the equipment is available for steam bending and a building form is already in place so that the ribs and planking, together with the keel, stem, and transom can readily be fastened together over it. In another book Monk makes the following comparison regarding the construction of round and vee-bottom boats. (10, page 1)

> The professional builder prefers the round-bottom type as it involves less labor being easier to set up and no chine to fit and bevel. The vee-bottom has been generally put forth as more suitable for the amateur, but I do not believe the choice of a boat should be decided from this viewpoint, but should rest on the purpose for which the boat is intended.

The professional may make the choice of the design presenting the most favorable lines which, in his opinion, fulfill the

immediate requirements; but the amateur must consider his equipment and experience.

The Qualities Desirable in a Boat for Use in Oklahoma. A boat should fulfill the requirements for which it was designed. A battleship has different requirements than a torpedo boat; a sailing yacht used for cruising the Atlantic is entirely different from the little sailing cat boat used on the inland lakes of America but they answer the demand for which they were built.

A boat used in Oklahoma should be small, probably not more than twenty feet in length. There are several reasons for this limit in size, among which is the original cost and the problem of transporting the boat from storage quarters to the lake that suits the fancy of the owner. It is probable that it will be hauled around on a trailer to the different lakes of the state, therefore, it should not be very heavy because the transportation problem may become too laborious and expensive for the average boat owner. A boat that is hauled around will receive additional strain on its hull not encountered in ordinary use, therefore, the owner should have a boat capable of withstanding the strain which he knows will be placed on it. When a boat is taken out of the water the planking will shrink, unless it is properly made, resulting in many small cracks which will leak when the boat is again put into use, it may soak up consider-

able water when put into commission, perhaps enough to expand the planking until the fastenings pull loose.

It may be seen that the requirements for a boat used in Oklahoma are varied but they can all be fulfilled if proper methods of construction are employed. It is believed by many boat owners and builders that the new product, resin-bonded plywood, will provide the qualities necessary in developing suitable boats for general use in Oklahoma as well as other areas.

Conclusion: Of the three general types of boat design, the flat-bottom and vee-bottom types are the easiest for amateurs to build and since the vee-bottom offers most of the desirable qualities found in round-bottom boats without the corresponding work and expense necessary in preparing for its construction; it may be concluded that this type is most appropriate for amateur builders or school shops. In the remaining section of this chapter the merits of water-proof plywood and its particular qualities desirable in boats designed for use in Oklahoma together with a summary of the equipment required and a suggestion for a larger and better lighted shop room than is demanded of regular industrial arts classes in woodwork will be included.

THE USE OF PLYWOOD IN BOAT BUILDING

Boat building is one of the oldest industries of America but only recently has it inaugurated the use of

plywood in hull construction. The conditions which led to this new application of plywood are the development of a resin bonding agent, impervious to water, and the hot-press system of uniting thin layers of wood with this resin, forming a waterproof plywood of a durability heretofore unknown. The many advantages of plywood for marine construction and its general acceptance by amateur boat builders, as well as commercial boat yards, tend to indicate that it is a product worth the consideration of the industrial arts teacher who may be contemplating a boat building program for his department.

A Discussion on Plywood. Plywood is made by gluing several plies, or sheets of wood together, forming a large unbroken surface. The plies are placed together with the grain of the wood in each layer, extending across the grain of the adjacent piece. Plywood is almost always made up of an odd number of thickness of wood so that the grain on opposite faces may run in the same direction, for example, 3-ply, 5-ply, 7-ply, etc. This factor in forming plywood sheets makes a wood product that obviates the ordinary tendency of wood to expand or contract; it also strengthens the wood along the grain resulting in a lighter, stronger material adaptable to practically all of the uses required of ordinary lumber, except in outdoor construction and marine work.

Plywood has been produced commercially since the latter part of the nineteenth century but only during the past decade has it been made in a manner suitable for marine use. This new adaptation of an old product was made possible by using a material known as plastic resin, instead of glue, between the plies, and treating under great pressure at high temperatures. Waterproof plywood, as the name implies, is waterproof. It can be used for outdoor and marine construction with perfect satisfaction and at the same time, retain all of the desirable characteristics found in ordinary plywood used for interior construction. Simmons makes the following observation in regard to plastic-bonded plywood. (12, page 37)

> The qualities which make plastic-bonded plywood ideally adaptable for marine construction are varied. In the first place, its durability is exceptional, because the laminated construction prevents the splitting and cracking to which solid timber is subject . . . This distribution of the grain also enables plywood to hold screws, rivets, and other fastenings without splitting.

At the present time there are five prominent manufacturers of resin-bonded plywood. Their names and addresses, together with the trade name of the waterproof plywood they manufacture, are given in the following list.

Harbor Plywood Corp., manufacturers of Super-Harboard, Hoquiam, Washington

Haskelite Mfg. Co., manufacturers of Haskelite, 208 Washington Street, Chicago, Illinois

Ipik Plywood Corp., manufacturers of Ipik, 1833 Canal Building, New Orleans, Louisiana

M. and M. Woodworking Co., manufacturers of Resnprest, 2301 North Columbia Blvd., Portland, Oregon

United States Plywood Corp., manufacturers of Weldwood, 616 West 46th Street, New York

The Ipik Plywood Corporation and the Haskelite Manufacturing Company are makers of the largest sheets obtainable. Some of these are 84 by 8-ft. panels and the advertising of the Haskelite Company would indicate that they produce plywood sheets up to one hundred feet long. The Higgins Industries, Inc., are using plywood sheets, in their construction of the navy torpedo boat, seventy to eighty feet long, that form a complete side of the boat from chine to sheer and transom to stem. The other manufacturers mentioned have so far been more or less concerned with the ordinary sized panels although the M. and M. Woodworking Company has made panels twenty-four feet in length. Any commercial lumber may be used in the manufacturing of waterproof plywood, fir being the most common, however for more durable and attractive boats, mahogany is used.

A Discussion of Adhesives Suitable for Plywood Cconstruction. The development of a plastic-resin suitable for use as a waterproof bonding agent in the manufacture of plywood has led to the discovery of a method or producing powdered resin, which, when mixed with water forms a convenient workable glue. This glue, unlike that which is used in the manufacture of plywood, requires no heat to set it above normal temperatures, yet makes a permanent waterproof

joint when used in wood construction. This powdered resin was first introduced to the public in the latter part of 1940 but has already received wide acceptance by craftsmen. Resin glue is being produced for commercial consumption under the trade names of Weldwood and Cascamite, manufactured by the United States Plywood Corp., 616 W. 46th Street, New York, and the Casein Company of America, 350 Madison Avenue, New York, respectively.

Resin glue may be used for the same purpose as animal or vegetable glues but has the added value of providing a permanent waterproof joint suitable for boat building, especially in plywood construction. Resin glue is not recommended for use in conventional boat construction where a flexible glue, knows as marine glue, should be used. The contraction and expansion of ordinary lumber would eventually break down the glue line. Plywood, on the other hand, having very little if any tendency to contract or expand, lends itself most readily to the gluing of all joints that provide a good gluing contact. Marine glue may be used instead of resin glue for plywood construction; however, it does not provide a joint that has any glue line strength; therefore, the strength of the plywood hull is not as great as when a permanent glue joint can be established because the "stressed cover" principle of plywood construction depends on rigid joints as does that of an airplane wing or body covered with plywood.

This writer has used resin glue exclusively in the construction of two small plywood dinghies and a seventeen-foot plywood sailboat and all of which have proved satisfactory. The sail boat has been observed for more than a year and there are no indications of a breakdown in any of the glued joints.

The Use of Plywood by Commercial Manufacturers of Boats. The late Charles G. MacGregor of the firm, Belmont and Payne, 115 Devonshire Street, Boston, Mass., was especially interested in the use of plywood for boats and probably did more than any other individual to promote and encourage the use of plywood for small boat construction. He designed and patented the Lawley 15-footer and the 8-foot plywood pram dinghy in 1937 and these boats were among the first, if not the first, boats of their type to be built commercially. MacGregor makes this statement regarding them. (6, page 132) "These two boats have been very successful, and there are hundreds of the pram dinghies now in use in this country and being shipped abroad." Although, ordinary plywood had been used to a very great extent in the interior of large boats it had never been practicable for use in the hull construction previous to the development of the resin-bonded type. In 1940, MacGregor made this statement regarding the number of plywood boats in use at that time. (7, page 54)

> It is no exaggeration to state that there are over 100,000 all-plywood boats in use in the country at the

> present time and this enormous fleet is being added to every day by the hundreds; and it is well within the realm of possibility that this new method of boat building will supplant the convertional methods (used by man for hundred of years) and that within the next generation of decade, through sheer pressure of popular demand.

When MacGregor wrote the above paragraph in 1940 he omitted a factor that is quite evident to Americans today; the pressure of war demands strong, light weight war craft capable of high speeds. The Higgins Industries, Inc., of New Orleans is building high-speed, triple screw motor torpedo boats in lengths up to eighty feet. These boats of the mosquito fleet are one of the best examples of the adaptation of plywood for marine use. The Higgins Company use only one piece of resin-bonded plywood to cover the complete side, from chine to sheer, of these 80-foot boats. As a confirmation of the previous success the Higgins Company has experiences using this material, they are developing plans for plywood boats up to 300 feet in length.

C. R. Simmons, Durey Plastics and Chemicals Inc., makes the following statements regarding the adoption, by commercial boat manufacturers, of plywood. (13, page 29)

> In 1937 and 1938 many well known manufacturers began using the new plywood. . . Lawley-Mumford Company are prominent users having developed an 8-ft. rowing andsailing pram in 1937 which incorporates radically new construction features. This unit was planked with 3/8 in. fir plywood, resin-bonded.

The faith, boat manufacturers placed in waterproof plywood a few years ago, is bearing fruit now in its use during the present international situation.

The Advantages of Plywood Construction Compared With Conventional Construction Used in Boat Building. A plywood hull derives its strength from the outer shell or planking, while on the other hand, a boat constructed in the conventional manner is no stronger than the keel and the frames to which the planking is fastened. Plywood construction is new but it offers many time saving and revolutionary methods of construction heretofore unknown to boat builders. In regard to the new possibilities waterproof plywood construction will make, MacGregor makes these unusual statements. (8, page 69)

> To say this new method of boat building made a complete change in small boat construction is putting it mildly. It has actually created a revolution in that staid old industry. Probably the first and only one in the past 500 years.

It must be remembered here, that MacGregor is considering the small boat.

The planking used in a plywood hull is only sixty percent as thick as that used in a boat of conventional construction. A boat ordinarily planked with seven-eighths inch stock can now be built of one-half inch plywood and still retain the same strength. A plywood boat requires fewer ribs and indeed some construction methods, discard them altogether. This insures simpler designs, easier building, and a much lighter boat which is a prime consideration when it is to be transported overland to any great extent. Plywood hulls have fewer joints or seams because the bottom may be put on in one piece or, in the case of a

vee-bottom boat, in two pieces; while conventional methods of boat building require the use of several pieces or strips providing a seam about every four or five inches which will require caulking and puttying, a considerable amount oftime being used for this operation. The use of plywood in boat hulls makes possible the gluing of all joints with waterproof glue insuring a water-tight hull and at the same time strengthening it. Fewer fastenings are required

TABLE 6

MINIMUM RADII TO WHICH PLYWOOD PANELS OF VARIOUS THICKNESSES CAN BE BENT

1/4 inch	lengthwise	minimum	radius	24 inches
1/4 inch	crosswise	minimum	radius	15 inches
3/8 inch	lengthwise	minimum	radius	54 inches
3/8 inch	crosswise	minimum	radius	36 inches
1/2 inch	lengthwise	minimum	radius	8 feet
1/2 inch	crosswise	minimum	radius	6 feet
5/8 inch	lengthwise	minimum	radius	10 feet
5/8 inch	crosswise	minimum	radius	8 feet
3/4 inch	lengthwise	minimum	radius	12 feet
3/4 inch	crosswise	minimum	radius	10 feet

in plywood construction because of the fewer seams. This insures faster and cheaper construction. Simpler repairs are required on plywood hulls since a hole can be patched up from the inside; while a similar puncture in a conventional boat might require the fitting of another strake. In planking a plywood boat the thinner material required is a definite advantage to the amateur builder who has had very little experience forcing heavy strakes into place. Plywood

can be bent over extreme curves as shown in Table 6 which lists the minimum radii to which panels can be bent. The information given here was obtained from the Douglas Fir Plywood Association, Tacoma, Washington, and published in The Rudder Magazine.

The fact that plywood can be used in thicknesses that require very little effort to bend into place should indicate that plywood construction for small boats is well within the facilities of the school shop.

The Limitations of Design in Boats for Plywood Construction. The advantages of water proof plywood for use in boats are limited to designs adaptable to plywood construction; or those which have been designed particularily for plywood planking. Boats suitable for plywood planking are the flat and vee-bottom types. Practically all flat-bottom boats are suitable for plywood planking but a vee-bottom boat may offer considerable difficulty in applying the plywood covering unless it has been designed especially for plywood. A boat suitable for plywood is designed in such a manner that there are no compound curves in either the bottom or the sides. The surface of a sphere is an example of a compound curve because there is no direction in which a line can be drawn that will produce a straight line. It can be seen that a piece of plywood or a small piece of paper cannot be placed flat on a sphere. If the surfaces of the boat are all simple curves, they can easily be covered with large sheets of plywood. There must be one direction on the curved surface on which a straight line can

be drawn as would be true on a cylinder or a cone which are examples of simple curves.

These restrictions do not mean that a good design cannot be obtained but they have led some concerns to denounce the plywood hull. For example, in a letter received from Westlawn Associates, Montville, New Jersey, was the following statements about plans for plywood boats.

> . . . After many years experience with this material there are but few boats whose plans we will willingly sell if plywood is to be used as planking. In no case will we sell plans for boats longer than can be planked in one sheet for any idea of butting these wide sheets end to end can only result in a boat so structurally weak that we would not allow our name to be associated with it.

Another criticism of plywood hulls is the following statement from a letter received from Motorboat, Sixty-three Beekman Street, New York.

> . . . As it is impossible to bend plywood to a compound curve boats so planked have to be of a boxy, homely type that would not be tolerated by a designing concern with a reputation to sustain.

With all due respect for the opinions of those who do not approve of plywood design, it is possible that the fundamental processes of designing boats with developable surfaces are not fully understood, as is indicated by the following statement by Charles P. Burgess. (1, page 34)

> . . . Strangely enough, it appears that very few designers, even among the professionals, know the solution to the problem and yet it is quite simple, and can provide the amateur with a lot of fun when he knows how the trick is turned.

There are many plywood boats in use today, and for the ordinary uses to which small boats under twenty or

twenty-five feet in length are subjected, it is likely that plywood construction and design will maintain an ever increasing popularity.

The Shop and Equipment Needed for Boat Building. A boat building program will require considerably more floor space than the ordinary industrial arts shop of Oklahoma provides but the investment in equipment should not be as high since special machinery is not required. The simplest hand tools are the most important.

The size of shop required will be determined by the number of pupils and the size of the boats to be made. Boats that range in size from six to twelve feet are popular in high school classes and a room twice the normal size of a woodworking shop should be adequate. Lighting, whether natural or artificial, should be more completely distributed over the room than would normally be required. This is necessary because of the fact that a boat is not so easily moved as are the smaller projects ordinarily made in a school shop which can be placed in any position to obtain the desired light.

The tool requirement for a boat building program of plywood construction is not great. Fewer work benches will be needed since considerable work is done directly on the boat and not requiring a bench or vise. In addition to a band saw, circular saw, and possibly a jointer, the following is a list of a few of the required hand tools: back saw,

cross-cut saw, brace and bits, screwdrivers, hammer, T-bevel, framing square, level, hand drill, spoke shave, jack plane, rabbet plane, chisels and an assortment of clamps of various types. A more complete list of tools and their uses will be given in Chapter VI.

In addition to the shop and equipment just mentioned, a space will be required on which to draw out the full sized plans of the boats to be built. This operation is known as lofting or laying down the lines. It can be done on heavy craft paper, on a large sheet of ordinary plywood, or directly on the floor. There are some advantages in laying down the lines on the side of a wall if it is of such nature that nails can be driven into it.

Conclusions and Recommendations. The preceding pages of this chapter have been devoted to a discussion of the types of boats and the various methods of their construction with a particular account of the advantages of waterproof plywood used in flat and vee-bottom hulls. With this discussion in mind it may be concluded that flat and vee-bottom boats are well adapted to construction by amateurs or by students in a school shop. Especially is this true if plywood construction is the method adopted by the builder. Round bottom boats, although easy to build in mass production methods, may not be suitable for school shops unless a vocational program of boat building is maintained, making possible the building of many boats on the same building form.

Flat and vee-bottom boats built of waterproof plywood are suitable for building in school shops. Their construction will enable the builder to learn techniques of construction that may be used in the factory or the home workshop; and in addition, these types of designs fulfill practically all of the requirements demanded by boat owners of Oklahoma.

CHAPTER VI

A SUGGESTED COURSE OF STUDY IN BOAT BUILDING FOR OKLAHOMA SCHOOL SHOPS

An outline of course content is an aid to the teacher in any field of class instruction. It is the purpose of this chapter to suggest objectives and the methods of their successful attainment through an organized plan of informational and procedure activities concurrent with the building of a boat. Suggestions are presented here to aid in the planning and organizing of a boat building class without undue expenditure of time and effort. The teacher will undoubtedly adapt and change many of the suggestions to his own particular needs.

The suggested course of study outline is based on several course outlines secured from various parts of America and on the actual experience this writer has had as an amateur in the field.

THE PURPOSES OF THIS COURSE OF STUDY

This course of study was developed as a result of the keen interest this writer has in boats and boating activities. It is patterned after the courses of study that have been published by the State Department of Education under the sponsorship of the State Advisory Committee for Industrial Arts in Oklahoma Schools.

Boat building can be introduced into the junior high school, but the course of study presented here has been designed for more advanced students who have had at least one unit in both mechanical drawing and hand woodworking.

Wide Industrial Arts Experiences Involved. Practically all of the objectives of the industrial arts program can be attained through the processes involved in boat building. Interest in foundry, drawing, sheetmetal work, machine shop practice, engine mechanics, electrical work, and other shop activities, is a natural result of a student's achievements in boatbuilding. The ambitious student will desire to make all of the hardware and rigging necessary for his boat and will be led automatically to pursue many of the fields of endeavor mentioned above. J. I. Sowers, Director of Vocational Education, Miami, Florida, outlines some of the variety of experiences provided by boat building courses in the following sentences. (14, page 202)

> . . . It is strange that boat building is not more generally introduced into vocational and industrial courses, especially in cities where boat building is a local industry. As a course it has many things to recommend it. Some of these are: (1) Students trained in this subject have command of many of the factors in several other trades, such as installing motors, wiring for lighting, cabinet making, wood finishing, plumbing, carpentry and many other minor operations.

The importance of this comment, published more than ten years ago, is more evident today than ever before. The industrial arts program maintained in the various schools of America, is striving continuously to provide courses in the

departments of industrial education that will allow for adequate avocational experiences. A course of this type seems to be one answer to the problem and should be practical in many schools of Oklahoma as well as those in industrial boat building centers.

The Nature of the Course of Study. In the formulation of this course of study, an attempt has been made to provide information and suggestions helpful in building a plywood boat of reasonable size. Because of the nature of plywood construction, only flat and vee-bottom boats are subject to the operations listed. The building of boats by conventional methods will require somewhat different operations and procedures but the fundamental units are practically the same as for plywood construction. Many problems will arise during the construction of a boat and this course of study is not intended to present a solution to all of them, but rather is a suggested outline of the major steps involved, with a description of the important operations necessary for the succesful completion of each.

RECOMMENDED TEACHING PROCEDURE

To present the problems and their solutions in boat building it is suggested that small boats be used as projects by the individual students. It is well, however, to allow two boys to work on the same boat as many of the operations require two workmen. Two boats or more can be

built on the same building jig and as one hull is completed it can be removed and a second boat can be begun by the other workman. Large boats requiring more than a year for building should not be attempted by the beginning student as he may lose interest in the project if the ultimate completion is postponed too long. J. I. Sowers, Miami, Florida, makes this statement regarding the lagging interest the student may develop in building a large boat. (15, page 203)

> It also has been learned that boatbuilding can be taught best by confining it to the making of smaller boats. When boats take a year or two to build students lose interest in them.

Most small boats for use in Oklahoma should not be too great a problem for the high school student.

The Presentation of Information. The technique of presenting information on boat building to the student is fundamentally the same as for other shop courses. This consists of (1) lectures, demonstrations, and class discussion; (2) actual shop activity in building boats, which should utilize at least eighty percent of the total class periods; and (3) tests and examinations over the units covered.

The Use of Textbooks and References: Textbooks should be used by the members of the class in boatbuilding. The two books, Amateur Boat Building by Crosby (3) and Boatbuilding by Chappelle (2) are recommended for this course in boat building. Many of the other textbooks and references listed in Chapter III should be available for additional information.

At least one current periodical should be available to the boat building students. The Rudder Magazine has the greatest universal appeal and is easy to read. If possible, the twenty-five back numbers of this magazine, published from March, 1939, to March, 1941, inclusive, should be secured from The Rudder Publishing Company, Nine Murray Street, New York. Each of these issues contains one of the series of article, "Plywood for Boats", by the late Charles G. MacGregor. They would be very helpful in understanding the operations given in this course of study outline.

Examples of Boat Building Outlines. The procedure of operations and units in boat building is not generally known by those having had no previous experience in this field and as an additional aid to the teacher in analyzing and evaluating the suggested course of study given in this chapter, summaries of three course outlines on boat and ship building that have been in use in American Schools are presented, (1) A Student Record and Progression Chart, E. H. Tomlinson Vocational School, 296 Muroe Lake Drive, St. Petersburg, Florida, (2) Job Operations, in a course outline, The State Department of Vocational Education, Elizabeth City, N. C., and (3) A Course Outline, Technical High School, 1401 N.E. Second Avenue, Miami, Florida. These outlines are presented in the following three sections of this chapter.

A Student Record and Progression Chart by C. H. Tomlinson Vocational School, St. Petersburg, Florida (Twenty-five Items)

1. Reading Plans
2. Handling Tools
3. Making Frames
4. Erecting Frames
5. Lining Up
6. Batten Construction
7. Chine Installing
8. Fitting Planking
9. Fairing Hull
10. Fastening
11. Caulking
12. Paving
13. Sanding
14. Joiner Work
15. Use of Tools
16. Bandsaw Work
17. Wood Working Machines
18. Care of Tools
19. Neatness with Work
20. Making Patterns
21. Installing Engine Beds
22. Lining up Engine
23. Finishing Interior
24. Painting
25. Safety

Job Operations in a Course Outline from The State Department of Vocational Education, Elizabeth City, N.C. (Thirty-one Items)

1. Study of drawings to be used.
2. Taking off lines from drawing and making full-size lines on floor
3. Make molds and patterns (Templet)
4. Get out keel, stern, and transom
5. Set up keel, stern, and transom
6. Set up molds and ribbands
7. Steam, bend, and set up ribs
8. Install floors and Keelson
9. Cut rabbet and set garboard
10. Study butt layout
11. Study scarfs in keel, shrinkages, clamps, and shelf stringers and chines
12. Methods of joining timbers
13. Apply planking, sheer strake and shutter
14. Layout deck, carlins with hatches and provisions for superstructure and deck equipment
15. Deck plank, sheer plank, king plank
16. House log and hatch coaming
17. Layout and install fenders
18. Blocking for sea cocks and plumbing
19. Layout and install chock rail
20. Install metal facing steam fenders transom corners
21. Install bulkheads
22. Build engine bed and shaft log
23. Skeg or deadwood, rudder tube and hangers
24. Provide for quadrant or steering equipment
25. Make tanks, foundations, and connections
26. Caulk hull and deck

27. Painting interior and exterior
28. Launching boat
29. Installation of deck hardware and spires
30. Installation of powerplant
31. The protection of the compass against magnetic disturbances

A Course Outline From The Technical High School in Miami, Florida (Twenty Items)

1. Mould Loft
2. Setting Up
3. Framing
4. Planking
5. Caulking
6. Hull Finishing
7. Decking
8. Outboard Joinery
9. Inboard Joinery
10. Painting
11. Spars
12. Rigging
13. Metal Work
14. Engine Installation
15. Plumbing
16. Electrical
17. Sailmaking
18. Upholstering
19. Patterns
20. Safety

These outlines were secured by corresponding with the persons in charge of these programs. The proposed course of study outlined in the fourth part of this chapter includes the principal items in the outlines just presented.

THE COURSE OF STUDY OUTLINE

The form of the outline found on the following pages is similar to those published by the State Department of Education. This technique of presentation is very effective and provides a more universal understanding for those accustomed to using it. The content of this outline is divided into thirty-two units, each of which contains the instructional procedures involved for the completion of each. The numbers in the columns, to the right of the instructional units, indicate the pages that information can be

obtained from the two books, the respective authors of which are given at the top of each column. The two references are listed below.

Chappelle, Boatbuilding (2)

Crosby, Amateur Boat Building (3)

A Course of Study in Boat Building
One year of work in high schools

Outline of Units of Instruction	Chappelle	Crosby
Unit 1. Selecting the Design		
A. The determination of a suitable design	25	1
1. The intended use		
2. Facilities of the shop		
3. The required size		
4. The type of design		
5. Type of construction		
6. Material available		
7. Shopwork ability of the builder		
8. Time available for building the boat		
B. Secure plans for the proposed boat	54	9
Unit 2. Laying Down the Lines, Lofting		
A. To make full size drawings of the boat lines	56	14
1. Secure a floor space somewhat larger than the projected boat		
2. Obtain a slender batten approximately 1/4" by 1/2", and a straight edge that is longer than the projected boat		
3. Draw the base line on the loft floor		
4. Draw a center line parallel to the base at a distance equal to the beam of the boat		

Outline of Units of Instruction	Chappelle	Crosby
5. Mark and draw the station lines perpendicular to the base line, long enough to extend across the plan and profile of the projected lines.		
6. Mark the distance from the center line out to the sheer, chine, and rabbet at each station on the plan.		
7. Mark the distance from the base line to the sheer, chine, keel, and rabbet at each station on the profile.		
8. The above dimensions may be transferred to the section in the same manner to provide an outline on which the frames may be built.		
9. Connect the points thus obtained, making a fair curve, using the slender batten. A straight edge is used to connect the points in the section drawing.		
10. Thickness of planking must be taken into consideration on all views.		
a. A line indicating the inside of the planking must be drawn on the plan and profile.		
b. The distance from the outside of the planking can then be deducted from the section lines and the lines drawn for the actual size of each frame.		
B. To project the transom.	125	89
1. Measure at right angles to the transom station, the distance from the sheer, chine, and keel that is given in the table of offsets.		
2. Connect these points with a straight line by using a straight edge.		
3. Draw the deck curve needed by using a slender batten.		
4. Provision must be made for the thickness of the planking and the angle of the transom.		
a. Draw a cross section of the transom and frame in the profile.		
b. Measure actual size of transom and frame to determine material required.		

Outline of Units of Instruction	Chappelle	Crosby
C. To lay out a full sized drawing of the stem.	85	52
1. Transfer dimensions given in the blueprint to the profile on the loft floor.		
2. Connect these points with a line using a slender batten suitable to the curvature required.		
3. Draw the outline of the stem face, rabbet, middle, and bearding line.		
Unit 3. Making the Frames		
A. To make boat frames.	275	28
1. Select proper wood.		
2. Saw stock to proper widths.		
3. Cut stock to proper angle and length for sections of each frame.		
4. Joint or saw bevels on each section of the frames.		
5. Saw out stock suitable for gussets and floors.		
6. Clamp or nail sections of the frame to the full size frame plan.		
7. Fasten gussets and floors to the frame sections.		
8. Fasten cross pawls or deck rib across the frame.		
9. Remove completed frame and repeat these operations for each of the other frames.		
10. Limbers must be cut in all frames except the transom.		
11. Use this operation for the transom frame, laying the frame sections on the projected transom. Provision must be made for angle of the transom.		
12. Trim gussets and floors to conform to bevel on each frame.		
13. Gussets and floors must be on same side of frame.		
14. All joints should be glued with resin glue.		
B. To provide a rigid frame work for the hull planking.	278	37

Outline of Units of Instruction	Chappelle	Crosby
Unit 4. Making the Stem		
A. To pick up the lines of the stem.	134	54
1. If stem is drawn on heavy paper, the lines can be prick punched through to the wood used for it.		
2. Large headed tacks may be laid on their sides along the curve of the stem and the stock pressed down over them to form the indentations suitable for determining the curve of the lines needed.		
B. To shape stem to desired form.	208	45
1. Select proper wood.		
2. Saw outside and inside outlines of the stock.		
3. Saw stempiece to provide fastening to keel and keelson.		
4. Cut the rabbet to easy tolerances.		
Unit 5. Making the Keel and Keelson		
A. To make a keel.	137	40
1. Select proper wood.		
2. Transfer dimensions from plan to stock.		
3. Saw and joint stock to specifications.		
B. To make a keelson.	137	40
1. Use same procedure as for making keel.		
C. To make a keel when both the keelson and keel are cut as one piece.	210	42
1. Secure suitable stock.		
2. Transfer dimensions from plan to stock.		
3. Saw and joint stock to size.		
4. Rabbet the keel for planking.		

Outline of Units of Instruction	Chappelle	Crosby
Unit 6. Setting Up the Building Jig		
A. To provide a strong frame on which to build the boat	142	62
1. Heavy longitudinal members are needed for rigidity.		
2. Upright cross braces are needed at each station to hold the frames and keel in position.		
3. Shoring must be provided to brace the stem, transom, and the frames while the building is in progress.		
4. A low roof is of considerable benefit for overhead shoring.		
5. The building jig should be level and provision must be made for a center line the whole length of the frame work.		
6. The building jig must be strong enough to retain its position during all the processes of construction work.		
7. Building jigs for small boats usually provide for constructing the boat upside down.		
B. To provide a permanent building jig.		
Unit 7. Fastening the Frames to the Building Jig		
A. To provide a firm support for the frames during the construction of the boat.	190	67
1. Fasten the frames at their proper station.		
a. Screw, nail, bolt, or clamp frames to the jig.		
b. Provide proper braces and shoring for each frame to prevent it from shifting during the building process.		
2. The gussets and floors will be on the forward side of the frames at all stations forward of amidships.		

Outline of Units of Instruction	Chappelle	Crosby
3. The gussets and floors will be on the stern side of the frames at all stations aft of amidships.		
4. The gussets and floor if any will be on the forward side of the transom frame.		
5. The center line across each frame must be vertical and must be in perfect alignment fore and aft.		
B. To insure uniform sides and bottom	119	68
Unit 8. Fastening the Stem to the Building Jig.		
A. To provide a firm support for the stem piece while keel and planking is fastened to it.	183	65
1. Fasten the projecting end with screws, nails, bolts, or clamps to the jig.		
2. Provide braces that will hold the stem in place while the keel and keelson are fitted. If possible these braces should remain in place during the entire building process.		
B. To insure a uniform, symetrical hull.	187	65
Unit 9. Fastening the Keelson and Keel to the Frames and Stem		
A. To fasten the keelson and keel permanently to the other parts of the boat structure.	173	65
1. Bend keelson into place and mark its position on the frames, transom, and stem.		
2. Cut out the necessary material in these members to provide a recess for the keelson and keel.		
3. Clamp keelson into place with the keel outside of it and bore the		

Outline of Units of Instruction	Chappelle	Crosby
necessary holes, and bolt through the stem and floors to provide adequate fastening.		
4. Screws may be used through the keelson to hold the keel in place at intervals between the frames.		
5. Resin glue should be used at every joint to provide additional holding power.		
B. To complete ribs and framework structure.		72
Unit 10. Making the Chines and Clamps		
A. To select suitable wood and make the chines.	224	76
1. Select tough flexible wood for chines.		
2. Saw and joint to proper dimensions.		
B. To select appropriate wood and make the clamps.	227	75
1. Select suitable wood for clamps.		
2. Saw and joint to proper dimensions.		
Unit 11. Notching Frames and Stem for Chines and Clamps		
A. To fit chines and clamps to the other parts of the structure.	228	74
1. Use a slender batten to bend around the frames to guide in cutting notches in the frames for the chine pieces and clamps.		
2. Mark and cut notches at chine and sheer for the respective pieces.		
3. Clamps on the inside of the frames used for holding deck ribs do not usually require a notch in the frame.		
4. Chines and sheer clamps must be let in far enough to be perfectly flush with the outside of the frames.		

Outline of Units of Instruction	Chappelle	Crosby
5. The chine will require beveling on one or both edges depending on the construction recommended.		
6. The chines must be let into the stem and transom and a knee should be provided on the inside for additional strength.		
7. It is not necessary to let the clamps into the stem, but knees should be provided at both the stem and the transom for extra holding power.		
B. To provide permanent joints for the stringers.	400	
Unit 12. Securing Chines and Clamps to the Frames and Stem		
A. To provide adequate fastening for the chines.	228	76
1. Use "C" clamps to hold chine pieces in place on the frames and at the stem.		
2. Drill holes through chine piece for fastenings.		
3. Remove chine pieces and apply resin glue to all points of contact.		
4. Clamp chine pieces into place and fasten permanently at all stations.		
5. Make and fasten knees at the transom and stem to strengthen the ends of the chines.		
B. To fasten clamps to frames and stem.	228	77
1. Use "C" clamps to hold clamp in place while holes are drilled for fastening to frames and stem.		
2. Remove clamps and apply resin glue to all points of contact.		
3. Clamp the sheer battens in place and fasten permanently to frames and stem.		
4. Provide a knee at each end of the sheer clamp.		

Outline of Units of Instruction	Chappelle	Crosby
5. Clamps used for holding deck ribs do not require additional reinforcing at the ends.		
Unit 13. Beveling Frames		
A. To cut proper bevel on all frames.	277	36
1. Bend a slender batten around the sides of the frames from stem to stern. 2. Plane off each frame until the batten will lie against it without any opening on either side of the frame. 3. Repeat these operations on the bottom of the frames.		
B. To provide a uniform bearing for all planking.	278	36
Unit 14. Rabbeting Keel, Chines, and Stem		
A. To cut rabbet bevel at the keel for planking.	42	41
1. The construction already completed on the keel and keelson has provided a rabbet along the keel. 2. Bevel this rabbet with a rabbet plane until a straight edge will lie flat against the shoulder of the keelson when extended at right angles across the chine at any point along the keelson. 3. The bevel of the keelson must be in line with the edges of the frames.		
B. To rabbet chine pieces.	42	
1. Chines may be constructed in two pieces and the inner chine needs only to be beveled or chamfered as given in the instruction for beveling rabbet.		

Outline of Units of Instruction	Chappelle	Crosby
2. The outer chine may be fitted after planking has been fastened.		
3. Provision for fastening planking must be made for the different angles which the bottom and side form at the chine.		
C. To rabbet the stem for planking.		52
1. Secure a sample piece of the planking to be used.		
2. Cut it to a width of two or three inches and long enough to reach back at least three stations.		
3. Use a chisel or rabbet plane, or both, to finish the stem rabbet so that the strip of planking will fit at the bearding, middle, and rabbet lines when it is bent around the frames to the stem.		
4. Stem rabbet must fair with the rabbet of the keel and must fair with the chine piece.		
Unit 15. Fastening Transom to Frame		
A. To fasten the transom board to the framing.	149	95
1. Select plywood or other material for transom.		
2. Saw out the transom piece using the dimensions obtained when a cross section of it was drawn.		
3. Fasten the transom to the frame using resin glue and screws from the inside.		
4. Completed edges of transom can be faired with the frames, keelson and chines.		
B. To make a beautiful stern.	152	98
Unit 16. Planking the Topsides		
A. To fasten plywood planking to the sides of the framing.	284	83

Outline of Units of Instruction	Chappelle	Crosby
1. Obtain suitable waterproof plywood in sufficient length to plank the entire side.		
2. Saw to rough overall dimensions for the side.		
3. Clamp plywood in place and mark the curvature of the stem rabbet on the front edge of the piece.		
4. Remove and shape to fit the rabbet of the stem.		
5. Clamp side piece back in place over the frames.		
6. Drill holes for fastenings at all necessary positions.		
a. Screws should be at least two and one-half times the thickness of the plywood.		
b. Screw holes should be spaced approximately eight times the thickness of the plywood at all joints where there may be an opportunity for leakage.		
c. Screw holes may be spaced more generously at other positions.		
7. Do not countersink screw holes in plywood. The screws will pull themselves down flush.		
8. Remove side piece and clean off all shavings and chips.		
9. All, or at least half, of the screws should be driven and then removed before the glue is applied.		
10. Apply resin glue to all surfaces to be fastened and clamp the piece into place with clamps.		
11. Drive screws as fast as possible, as the glue sets up quickly in warm weather.		
12. Wipe off excess glue and plane edge of the side down to the face of the chine piece.		
13. Repeat the operations for other side.		
B. To fasten conventional planking to the topsides.	289	83

Outline of Units of Instruction	Chappelle	Crosby
Unit 17. Planking the Bottom		
A. To fit plywood on the bottom of a vee-bottom boat.	284	83
1. Secure waterproof plywood, large enough to cover one entire side of the bottom.		
2. Saw to rough outline.		
3. Make a spiling plank and obtain outline for the bottom at the keel.		
4. Mark outline on the material and saw to the line.		
5. Clamp bottom piece in place and mark additional places for fitting.		
6. Plane bottom piece to fit keel rabbet.		
7. Clamp bottom to the framing and drill holes for fastenings as suggested for the sides.		
8. Remove bottom and clean off chips and shavings.		
9. All, or at least half, of the screws should be driven and then removed before the glue is applied.		
10. Apply resin glue at all points of contact and clamp bottom into place.		
11. Drive screws.		
12. Wipe off excess glue and plane the edge down to the face of the chine.		
13. Repeat the above operations for the other side.		
B. To fit and fasten outer chine.	138	80
1. The edges of the sides and bottom should be protected by the outer chine which should fit in the space formed by the angle between their edges.		
2. Glue and fasten with screws a suitable piece of material along these two edges.		
3. Easier but poorer construction is to lay the bottom directly over the edge of the side which exposes the cross section of the plywood.		

Outline of Units of Instructions	Chappelle	Crosby
Unit 18. Faring Stem, Keel, and Chines With the Planking		
A. To secure a smooth uniform hull.	249	152
1. Plane off that part of the outer chine and keel which projects above the planking. 2. Plane sides of stem to conform to the sides and bottom of the hull. 3. Mix resin glue with fine sawdust to form a putty and fill any holes or depressions in the outer hull. 4. After putty has dried, sand complete hull until it is perfectly smooth and ready for paint.		
B. To insure a suitable surface for painting.	252	152
Unit 19. Painting Outside of Hull		
A. To apply durable paint to the completed hull.	545	152
1. Obtain enough flat boat paint and apply at least two coats on the outside. 2. Apply paint to the hull as recommended by the manufacturer. 3. Secure and apply at least two coats of gloss or semi-gloss topside paint to the hull as recommended by the manufacturer. 4. Sand lightly between each coat.		
B. To provide a pleasing color and permanency to the hull finish.	548	152
Unit 20. Removing Hull From Building Jig		
A. To provide a suitable frame for supporting the newly painted hull while interior construction is done.		
1. Make a cradle to fit the hull at two stations to hold the weight of the boat.		

Outline of Unit of Instruction	Chappelle	Crosby
2. Pad the cradle with canvas, webbing, or other suitable material to form a non abrasive cushion.		
3. Make cradle strong enough to hold boat securely during subsequent construction.		
B. To place hull on padded cradle.		
1. Remove all shoring and bracing from the framework of the inverted hull.		
2. Secure adequate help to lift boat bodily from the building jig.		
3. Turn hull on its side on two or three burlap sacks filled with sawdust and shavings so that the finish will not be marred.		
4. Turn boat over to an upright position on the padded cradle.		
Unit 21. Making Centerboard Trunk		
A. To provide a water-tight centerboard trunk for sailboats.	156	180
1. Secure material for sides and bed logs.		
2. Saw bed logs to fit the interior of the keel or keelson.		
3. Rabbet bed logs for trunk sides.		
4. Fasten the sides to the respective bed logs with bolts or screws, using resin glue at all joints.		
5. Secure soft wood for spacers between sides of trunk and cut them long enough to extend through the keel when the trunk is installed.		
6. Fasten the trunk together at each end with bolts (preferably) through the sides and spacers. Use resin glue on the joints.		
7. Interior of trunk should be painted with at least four coats of marine paint, before assembly, if possible.		
B. To provide a strong, rigid centerboard well.	159	182

Outline of Unit of Instruction	Chappelle	Crosby
Unit 22. Installing Centerboard Trunk		
A. To install the centerboard trunk in the hull of a sailboat.	158	186
1. Locate the position of the centerboard slot and saw through the keel according to the size specified. 2. Smooth the sides of this opening with a chisel or wood file and place the centerboard trunk into position with the spacers extending through the keel. 3. Plane the bottom surface of the bed logs until a perfect fit is obtained between these members and the inside of the keel. 4. Bore appropriate holes through the bed logs and keel for bolt fastenings. 5. Remove chips and shavings and apply resin glue to all surfaces of contact. 6. Bolt the trunk to the keel with proper bolts and wipe off excess glue.		
B. To provide a permanently leak-proof trunk.	159	182
Unit 23. Making Engine Bed and Installing Engine		
A. To make an engine bed for supporting the power plant.	491	111
1. Secure hard wood suitable for withstanding the vibrations of the engine. 2. Check plans and locate the angle and position of the shaft through the shaft log or keel. 3. Bore hole for the shaft at proper angle. 4. Line up the position of the engine through the shaft hole and locate the position of the stringers. 5. Saw stringers to fit the hull and fasten into place. 6. The instructions of the engine manufacturer should be followed as to the construction of the bed and the position of the engine hangers.		

Outline of Units of Instruction	Chappelle	Crosby
B. To install an inboard motor after hull is completed and painted.	490	117
1. Provide overhead beams or supports for hoisting engine above the hull.		
2. Hoist the engine above the engine bed and lower into place.		
3. Line up the engine with the propeller shaft and bolt it in place.		
4. Provide a drip pan underneath the engine.		
5. Fasten propeller shaft to engine take-off.		
6. Fasten propeller shaft housing and bearing to the hull.		
7. The instructions for installation of the engine are usually furnished by the manufacturer and should be followed carefully.		
Unit 24. Sawing and Installing Deck Ribs		
A. To make deck ribs by sawing the camber in the stock.	111	122
1. Lay out a full size drawing of the deck rib to be used at the greatest beam.		
a. This may be done directly on the rib stock.		
b. Use method recommended by the designer.		
2. Saw and shape to proper outline. Be sure the curvature of the ribs is the same on both sides of the center line.		
3. Mark off the outlines of all necessary ribs from this pattern and cut to shape. Work from center line of pattern.		
B. To install deck ribs.		
1. Follow the procedure shown by the designer.	255	128

Outline of Units of Instruction	Chappelle	Crosby
2. Be sure that sufficient support is provided each rib.		
Unit 25. Painting Interior of Hull		
A. To paint the interior of the hull for durability.	545	152
1. Secure suitable marine varnish or paint sufficient for at least three coats on the interior. 2. Brush or spray (brush preferable) all surfaces on the interior of the hull. 3. Follow directions recommended by the paint manufacturer for application of each coat.		
B. To provide pleasing interior.	545	132
Unit 26. Covering the Deck.		
A. To provide a water tight covering for a sail boat.	260	132
1. Secure plywood sufficient to cover deck. a. Any seams should be made down the center line of the deck. b. Seams should be rigid so that a crack will not open up. 2. Paint underside of deck material at least two coats and nail to the deck ribs and sheet clamp with galvanized or copper nails. 3. Plane off any protruding edges flush with the topsides and interior of cockpit. 4. Paint top of deck with two coats of marine paint and stretch eight-ounce canvas over the entire deck while the second coat is still wet. 5. Tack all edges of the canvas with copper tacks and trim off excess material.		

Outline of Units of Instruction	Chappelle	Crosby
6. Paint canvas deck covering, at least two coats.		
B. To provide a natural finished deck for small boats.	315	134
1. Secure suitable material according to the recommendations of the designer.		
2. Install and finish the decking according to the instructions given by the designer.		
Unit 27. Making and Installing the Centerboard		
A. To make a steel centerboard.		
1. Obtain the required metal plate and have the welding shop cut it to proper dimensions and shape.		
2. Grind edges to a round cross section and drill necessary holes.		
3. Plate may be galvanized if a galvanizing plant is in the area.		
4. A good grade of aluminum paint for marine use gives best results if a galvanized board is not obtainable.		
B. To make a wood centerboard	152	184
1. Follow the specifications given in the designer's plans.		
C. To install the centerboard in the trunk.		
1. Locate position of the centerboard pin and bore through the bed logs of the trunk.		
2. Insert pin and bushing as recommended by the designer.		
Unit 28. Making Spars		
A. To make a square hollow box type mast.	564	165
1. Select spruce or other wood suitable for spars.		

Outline of Units of Instruction	Chappelle	Crosby
2. Saw and joint two pieces to proper dimensions for side of mast.		
3. Prepare other pieces in the same manner to be used on the other two sides of the mast.		
4. Prepare filler blocks for the specified positions in the mast.		
5. Filler blocks may be shaped to size by planing them down as the sides of the mast is being planed to size.		
6. Apply resin glue to inside of the two pieces of the mast and nail lightly to the filler blocks.		
7. Apply resin glue to the inside of the side pieces of the mast and nail lightly to the other members of the mast structure.		
8. Use "C" clamps or equivalent and clamp the assembled parts at positions not more than twelve inches apart.		
9. Back side of mast must be perfectly straight longitudinally.		
10. Check mast for wind and straightness.		
11. When the glue has dried, remove the clamps and pull the nails.		
12. Cut slot for halliard shieve and square shoulder for step tenon.		
12. Plane and sandpaper mast smooth and round corners to a radius equal to the thickness of the side pieces of the mast.		
14. Apply at least three coats of marine varnish to the mast.		
B. To make a solid round mast.	560	
1. Secure a piece of spruce of other suitable wood large enough for shaping to the finished size. Stock may be glued up from two or more pieces.		
2. Saw or joint the stock, to form an octagonal cross section.		
3. Use a plane or spokeshave to round corners.		
4. Sand and finish mast as suggested above for hollow mast.		

Outline of Units of Instruction	Chappelle	Crosby
C. To make a solid boom.	555	172
1. Secure suitable stock and saw and plane to required dimensions and cross section.		
2. Smooth and finish according to suggestions given for masts.		
Unit 29. Making the Rudder		
A. To make a wood rudder.	160	202
1. Secure proper material.		
2. Make a full size drawing of the rudder.		
3. Place pieces for rudder over the drawing to mark position of dowels.		
4. Bore holes for dowels and glue stock together with resin glue.		
5. When glue is dry, the pattern may be transferred to the stock and the outline sawed out on a band saw.		
6. Shape cross section as specified by the designer.		
7. Finish with marine paint or varnish.		
B. To make a metal rudder.		205
1. Secure suitable material such as bronze if possible, galvanized steel will answer.		
2. Have welding shop cut the stock to desired shape.		
3. Follow the specifications given by the designer.		
C. To make a tiller or steering apparatus.	165	207
1. The specifications of the designer should be observed.		

Outline of Units of Instruction	Chappelle	Crosby
Unit 30. Making and Installing Miscellaneous Items		
Many units such as the rigging, both standing and running; the chocks, cleats, etc., cannot be discussed here because of limited space. There are such numerous and diversified arrangements of these various items that it will be necessary to refer to the specifications and recommendations of the designer during construction.	582	171
Unit 31. Making the Sails		
Making sails is an art within itself and lack of space prevents any methods of procedure being given in this course of study, however, the student who desires to make his own sail may consult Sailmaking Simplified by Alan Gray, for complete instruction in the process.		
Unit 32. Transporting the Boat		
To provide safe and dependable means of transporting the small boat, the cradle that was used during the subsequent building operations after the hull was removed from the building jig may be placed on a two-wheel trailer in such a position that the weight of the boat will balance slightly forward of the wheels. A special trailer may be made for this purpose if the boat is to be hauled extensively, but the former suggestion is quite adequate if properly managed.		

Special Hardware Used in Boat Building. The hardware and fastenings suggested by the outline for use in boat construction is certainly not comprehensive. The nature and quality of these items will be determined by the extent and the conditions

of their intended use. The recommendations of the designer should be observed in most cases.

Regarding nails, there is a special type of boat nail for use in fastening the various members of the boat structur and it should be used where recommended. The ordinary common and box nails, though galvanized, are not strong enough to be driven and do not provide the necessary holding power required in most joints.

Flat-head screws are used extensively in fastening the plywood planking. The quality of the screw for the intended use must be considered. Brass screws though widely used in construction for fresh water craft are soft and do not last in salt water. Galvanized screws have proved practical for many uses in marine construction but are used only in the larger sizes because of the tendency for the zinc to roughen the surface of the screw threads. Bronze screws are unsurpassed for most marine construction but are somewhat more expensive than any of the other kinds mentioned. The tendency of the ends of the slot in the head of the common screw, to tear out some of the fibers ajacent to the hole, is particularly objectionable in fastening fir plywood. To eliminate this characteristic the "Phillips Head" type may be used. This type of screw is ideal for amateurs to use because any slippage of the screwdriver is avoided.

Other fastenings, such as bolts, lagscrews, and etc., should be obtained and used to fulfill the necessary requirements specified by the designer.

A chain is no stronger than its weakest link. Especially is this old axiom true when applied to boat building. Cheap and inferior fastenings should never be allowed to determine the permanency of the construction of any boat.

DEFINITION OF TERMS USED IN THE COURSE OF STUDY OUTLINE

Many of the terms and expressions used in the preceding outline are new to the average teacher or student, but a knowledge and understanding of them will be necessary before the work of building a boat can progress very far. With this in mind, a list containing a limited number of the special boatbuilding terms and their definitions, is given in the following pages. These definitions are taken from A Glossary of Sea Terms by Gershom Bradford.

Aft, towards the stern.

Amidships, usually in the line of the keel, but sometimes mid way between bow and stern.

Battens, are strips of iron that fit over staples in the hatch coamings and secure the tarpaulins. When securely wedged the hatches are then said to be battened-down. Wooden battens are long, slender strips placed in lateen sails to support and hold the form; sometimes in the leeches of racing sails. Battens are placed about the rigging to save the gear from chafing. Cargo battens are long planks in the holds and between decks along the ship's sides to protect the cargo from sweat and rust.

Beam, the greatest breadth of a vessel.

Bearding, the reduction of surface in a timber from a given line.

Bed, is the general term given to the foundation of an engine, boiler or any other object of weight.

Boat, as used by seamen the term does not apply to a vessel, but to small craft, although river and excursion steamers are quite generally called boats. To boat your oars is to lay them across the thwarts after rowing. Boat, as distinguished from the general term ship, is constructed of bent frames and a vessel or ship of sawn frames. (This is the opinion of a shipbuilder.)

Bow, the forward part of a vessel. Sometimes used in the plural as, in the bows of a ship.

Centerboard, a keel-like device that is capable of being hoisted and lowered in a well for the purpose of adding keel area to a sailing craft. When down the leeway is much reduced. The water-tight box inside the vessel that receives the board when hoisted is called the centerboard trunk. The centerboard is sometimes called a drop keel and sometimes a center keel. The primary object of a centerboard is to facilitate the sailing qualities of a shoal draft boat.

Chine, the line of intersection between the sides and bottom of a flat-bottomed boat; the angle in the planking of a vee-bottomed boat.

Cleat, a piece of wood or metal with two horns around which ropes are made fast.

Cradle, a frame of timber erected under a vessel to support her on the ways until she waterborne. Supporting skids under a boat.

Cross Pawls, timbers temporarily fastened across the frames to secure them during the construction of a vessel.

Deadrise, the rise of the floor of a vessel above the horizontal. It is the rise of the sides of a vessel's bottom above the base line at the intersection with the moulded breadth line.

Deck, what floors are to a building so are decks to a vessel.

Fair, a line leading straight or running freely. Smoothing out dented plates or restoring dislocated frames in a steel vessel.

False Keel, a timber added to the main keel of a vessel to increase the draft or to protect the keel.

Fin Keel, a deep keel of small extent usually of lead; it brings the center of gravity very low, and allows the carrying of a large sail area.

Floor, the lower portion of a transverse frame, usually a vertical plate extending from the center line to the bilge and from inner to outer bottom.

For and Aft, in line of the keel.

Gusset, a wood plate to reinforce the frames at the chine.

Hull, the main structure of a vessel.

Keel, the backbone of a vessel, from which rise the frames or ribs, stem and sternpost.

Keelson, a timber or steel stringer bolted on the keel in the hold for reenforcement.

Masts, vertical spars set in ships primarily for setting sail.

Mold Loft, a loft where the lines of a vessel are laid down.

Open Boat, an undecked boat.

Rabbet, a channel or longitudinal recess cut in the face of a timberjor plank, as the rabbet in the keel to receive the garboard strake, or the ends of the strakes of plating.

Ribband, a fore and aft wooden strip or heavy batten used in ship construction temporarily to support and mark the position of the transverse frames.

Rudder, a contrivance consisting of wood or steel plates fastened together to form a flat structure used in steering a boat.

Running Rigging, all those lines that are used to control the sails, such as halyards, clewlines, buntlines, etc. Lines that move when in use in distinction from standing rigging such as shrouds, backstays, etc., which are working in a permanent position.

Sails, pieces of canvas of every size and shape set from masts, yards, booms and gaffs for the purpose of propelling a vessel by wind power.

Sheer, the upward curve of the deck.

Shore, a support; and, as a verb, to support.

Skeg, additional timbers added to deepen the keel in the after part of the vessel or small boat; an extension of the deadwood which protects the propeller from the ground.

Spar Varnish, a varnish of superior quality for outside work on shipboard. It is not affected by salt water, heat or cold.

Spars, a term applied to all masts, yards, gaffs, boom, etc.

Stem, the foremost timber or steel bar in a vessel. It is joined to the keel, and all the planks, or plates, are babbeted or riveted to it.

Step, a frame structure prepared either on the keelson or a lower deck to receive the heel of the mast.

Stern, the after part of a vessel.

Stop-water, a treenail driven through the stem and keel where they join at the forefoot. A packing of felt set in lead between two plates to make a watertight joint.

Tail Shaft, that section of the shaft passing outboard through the stuffing box and to which the propeller is keyed.

Tenon, the projecting member of a mortise; the prepared part of the foot of a mast that fits into the step.

Tiller, a bar of iron or wood connected with the rudder head and leading, usually, forward. By the tiller, the rudder is moved as desired.

Topsides, lie between the waterline and the ship's rail.

Transoms, the athwartship timbers of a vessel bolted to the sternpost. The floor, frame and beam that comprise the transverse member at the sternpost are designated the transom floor, transom frame and transom beam. They are usually of heavier dimensions owing to the overhang which they in part support.

V-Bottom, Vee-Bottom, a type of boat building with a sharp angle at the turn between the sides and the bottom instead of the ordinary rounding side. The boat is very sharp forward but the bottom becomes flat aft. The chime is very pronounced forward. It is a speedy, seaworthy type.

Yacht, a sail, steam, or motor vessel used for pleasure, and usually a fast, finelined craft. Yachts of sufficient tonnage to require documenting sail under a legal paper called a license.

These are but a few of the more than 4,000 terms relating to boat building and the sea which are included in the complete glossary from which this list is taken. The amateur builder or operator of boats must know these, at least.

TOOLS REQUIRED FOR BOAT BUILDING

The suggestion has been made in another section of this study that the tools found in the average Oklahoma high school woodwork shop, would be adequate for use in a boat shop. The nature of boatbuilding is such that handwork is by far the most important phase of job operations. The advantages of having certain machines for ripping stock, drilling holes, and sawing a curved outline should not be minimized but their importance in teaching boat building is negligible. On the other hand, the tools used in manual operations are of prime necessity. Although, most of the tools required for these operations are usually found in the woodworking shop, there are some of them that will be used more persistently in boat building than in the regular classes of woodwork, thus requiring a slight additional expenditure for these items. In organizing and equipping a new woodworking shop, the savings possible on the purchase of work benches would be sufficient to justify the few additional tool items.

Machines. The woodworking machines most helpful in teaching a class in boat building are, table saw, band saw,

jointer, grinder and drill press. Portable electric hand drills and sanders are of considerable benefit in speeding up the work. By shortening the time required for the actual building, interest of the student is more easily sustained, and this is an important factor in building a large shop project, such as a boat.

Hand Tools. In addition to the number of appropriate tool items used in woodworking, a few groups will need the number increased for boat building classes. Among those tools, a greater number of which will be required are the following. Hand drills, braces, rabbet planes, hack saws, spirit levels, chalk lines, plumb bobs, "C" clamps, automatic screwdrivers, T-bevels, framing squares, dividers, spoke shaves, and portable tool boxes or kits. The availability of tools, as suggested in the preceding paragraphs might indicate the possibility of many schools accepting a course in boat building because of the necessity of avoiding the unusual expenditures found in many other shop work activities. The fact that a large expenditure for tools is unnecessary, is no indication of the merits of a course in boat building. The statements made earlier in this chapter regarding the avocational possibilities of a course in boat building should be kept in mind, particularly when the next and concluding chapter is examined.

This chapter, suggesting a course of study in boat building, is necessarily incomplete. Much more could be

said about methods, materials to be used, techniques of shop planning and many other related subjects. The purposes of this thesis have been realized in including the brief outline for the course of study.

A final statement summarizing the primary materials included in this study, specific conclusions and the making of certain recommendations will constitute the closing chapter.

CHAPTER VII

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The findings of this study will be presented in this chapter in two divisions; (1) summary of the discussion and (2) a statement of definite conclusions made on the basis of information presented. In addition to the brief summarization of the material and the statement of conclusions, a few recommendations are given in this final chapter.

A Summary of the Findings. In the summary of this study an attempt will be made to present those significant data and other informational background, in a manner that will insure a comprehensive perspective of the problem as a whole.

Boat building has always been an important part of the lives of many people in every race. Boat building, and particularly ship building, is today one of the most gigantic industries of all times. The materials used in industry are the best that modern science can produce, but in spite of the fact of these superior materials in use today, the industry is limited in its building program to types and designs of boats that are within the limitations imposed by the material used. This was also true of the boats produced by primative man, who could only build those things which were within the limitations of the material obtainable in his age.

The recent production of waterproof plywood and resin glue has relieved the limitations imposed on small boat builders. The quality and uniformity of this new material suitable for making permanently water-tight hulls, has opened a new field of possibilities within the realm of the inexperienced who prefers to build his own boat.

During the past decade, the United States Government has subsidized local and state agencies in the building of huge dams throughout America. Many of these dams have been built and are being built in Oklahoma, providing unusual facilities for boating on the water impounded by them.

Of the 2,336,434 people living in Oklahoma, it is estimated that almost half of them live within twenty miles of a good lake. There are more than 600,000 people living in cities of more than five-thousand population that are within a diving radius of twenty miles of one or more large lakes of more than ten acres in size. The aggregate acreage covered by the two hundred lakes listed in this survey is more than 400,000 acres, extensive enough to provide adequate boating facilities for the thousands who desire to use them.

The literature of the field as listed and discussed in a preceding chapter is of recent publication. Recency and newness is also typical of the boat building schools and classes being conducted at the present time. The recency of the factors just mentioned is an indication of a growing interest in the subject this problem considers.

The section of this study devoted to types of boats is limited to a review of type of construction and materials used in producing a desirable boat suitable for use in Oklahoma.

As a further step in the development of this problem, a course of study has been suggested to aid in the organization and teaching of a course in boat building in a school shop. The units and instructional information presented, are not complete but should be helpful in understanding the procedure sequence involved in the building of a plywood boat.

Conclusions. Boat building and the corresponding activities relating to this activity, have a universal appeal. By appealing to the interests of youth, educators hope to accelerate the learning process of pupils in all levels of school learning. In many schools a shop program of boat building would provide adequate teaching opportunities in most of the fundamental tool operations required in the average woodworking project and in addition, would create a realization of the need for other shop courses designed to enable the student to develop interests and knowledges of an avocational nature. Some of the related courses, boat building students should become interested in are listed as follows:

1. Drafting
2. Layout Work
3. Sheet Metal Work
4. Machine Shop
5. Foundry
6. Electricity
7. Carpentry
8. Finishing and Painting
9. Engine Mechanics
10. Pattern Making
11. Upholstering
12. Cabinet Making

As has been suggested earlier in this study, the ambitious student building a boat will necessarily be led into some of the many studies mentioned above, because he has a need for the things that may be made while working in these areas. For example, patterns of the fittings necessary can be made and cast in the foundry. Turnbuckles, shaft housings, the steering apparatus, and various other equipment can be machined in the machine shop. Installation of engines and wiring connections require knowledge of engine mechanics and electricty. Engine cowlings, drip pans, guards, and other items will require layout work and sheet metal construction. Work in upholstering and painting are practical results of the desire of the student to have a pleasing and serviceable boat.

The avocational functions a course in boat building provides are further supplemented by the creation of wholesome recreational activities such as rowing, sailing, motorboating, cruising, racing, and other outdoor sports, which in turn may call for a knowledge of navigation and the other fields of celestial science related to it.

As might be supposed from the aforementioned suggestions, the merits of a course in boat building are significant

in that it provides a means of attaining the objectives of the industrial arts program through a new appeal.

Suggestions and recommendations are given as the final section of this thesis to aid in the formation of definite ideas relative to the functions resulting from this study.

Recommendations. As a consideration of the number of people in Oklahoma who live near large lakes, and further, realizing the opportunities provided by waterproof plywood and resin glue for amateur boat construction, the following recommendations are suggested to aid in the formation of a more comprehensive school shop program.

1. Schools having pupils enrolled that are interested in boat building, should provide an opportunity for them to receive instruction and experience in that field.

2. Schools located near possible boating areas should analyze the benefits a boat building course might provide.

3. Shops having suitable equipment for metalworking should permit and encourage students to make and repair the hardware and other accessories they may use on their own or their friend's boat.

The three recommendations just given are merely suggestive but their adoption and use may be of significant importance in an era of short working hours. The free periods at school, the adolescents desire for activity, and the possibility of uniting the father and son, and even the whole family, in a wholesome outdoor sport, are prime factors in determining the content of present-day school curricula.

A SELECTED BIBLIOGRAPHY

1. Burgess, Charles P., "Developable Surfaces for Plywood Boats," The Rudder Magazine, 56:34, February, 1940.

2. Chapelle, Howard I., Boatbuilding, W. W. Norton and Company Inc., New York, 1941, 624 pages.

3. Crosby, W. F., Amateur Boat Building, The Rudder Publishing Company, Nine Murray Street, New York, 1938, 235 pages.

4. Crosby, W. F., Amateur Boat Building, The Rudder Publishing Company, Nine Murray Street, New York, 1938, 235 pages.

5. Crosby, W. F., Teal, "Proposed Racing Class," The Rudder Magazine, 57:36, November, 1941.

6. MacGregor, Charles G., "Plywood for Boats," The Rudder Magazine, 56:132, January, 1940.

7. MacGregor, Charles G., "Plywood for Boats," The Rudder Magazine, 56:54, April, 1940.

8. MacGregor, Charles G., "Plywood for Boats," The Rudder Magazine, 56:69, September, 1940.

9. Monk, Edwin, Small Boat Building, Charles Scribner's Sons, New York, 1934, 113 pages.

10. Monk, Edwin, Modern Boat Building, Charles Scribner's Sons, New York, 1939, 103 pages.

11. Nichols, Fred R., "Every Boy Wants to Build a Boat," The Rudder Magazine, 58:16, June, 1942.

12. Simmons, C. R., "Little Boats," Modern Plastics, 19:37, March, 1942.

13. Simmons, C. R., "Plywood Joins Marines," Modern Plastics, 17:29, May, 1940.

14. Sowers, J. I., "A Vocational Course in Boatbuilding," The Industrial Arts and Vocational Education Magazine, 20:202, June, 1931.

15. Sowers, J. I., "A Vocational Course in Boatbuilding," The Industrial Arts and Vocational Education Magazine, 20:203, June, 1931.

Inquiry Sheet on Boat Building in American Schools

1. Have you ever had boat building classes? _____

2. Do you have any boat building classes at the present time? ..... _____

3. Are your classes of a vocational nature or regular industrial arts type?..... _____

4. How long has your present course been in operation? ..... _____ years

5. Does your course operate under the direction of the state department of education?.. _____

6. How many pupils are in each class?..... _____

7. What texts do you use?

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

8. What periodicals do you use?

1. _____

2. _____

3. _____

4. _____

9. How much time is spent in actual boat building work?..... _____ hours per week

10. How much time is spent on related subjects? ..... _____ hours per week

11. What comments do you care to make on your boat building course?