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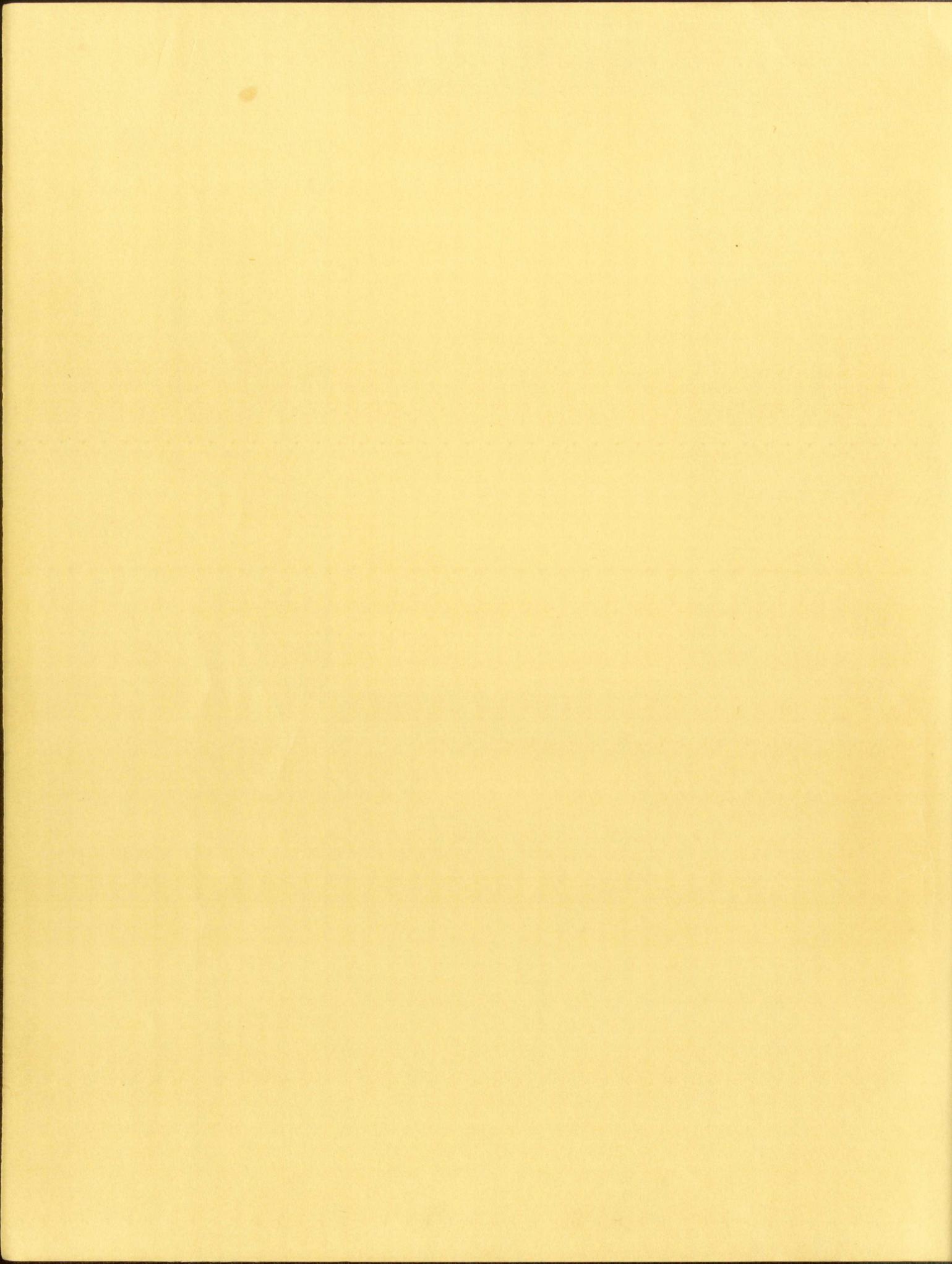
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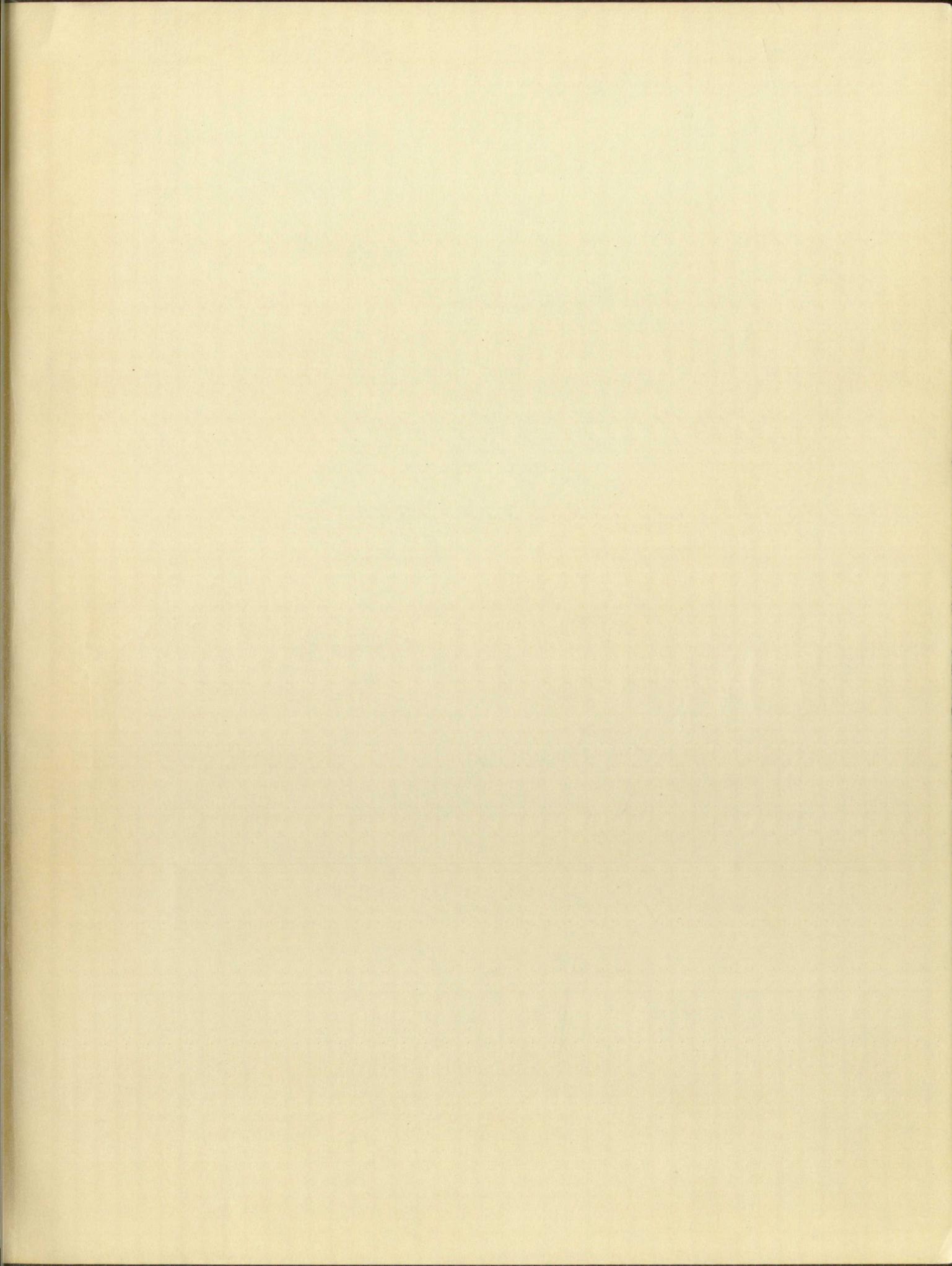
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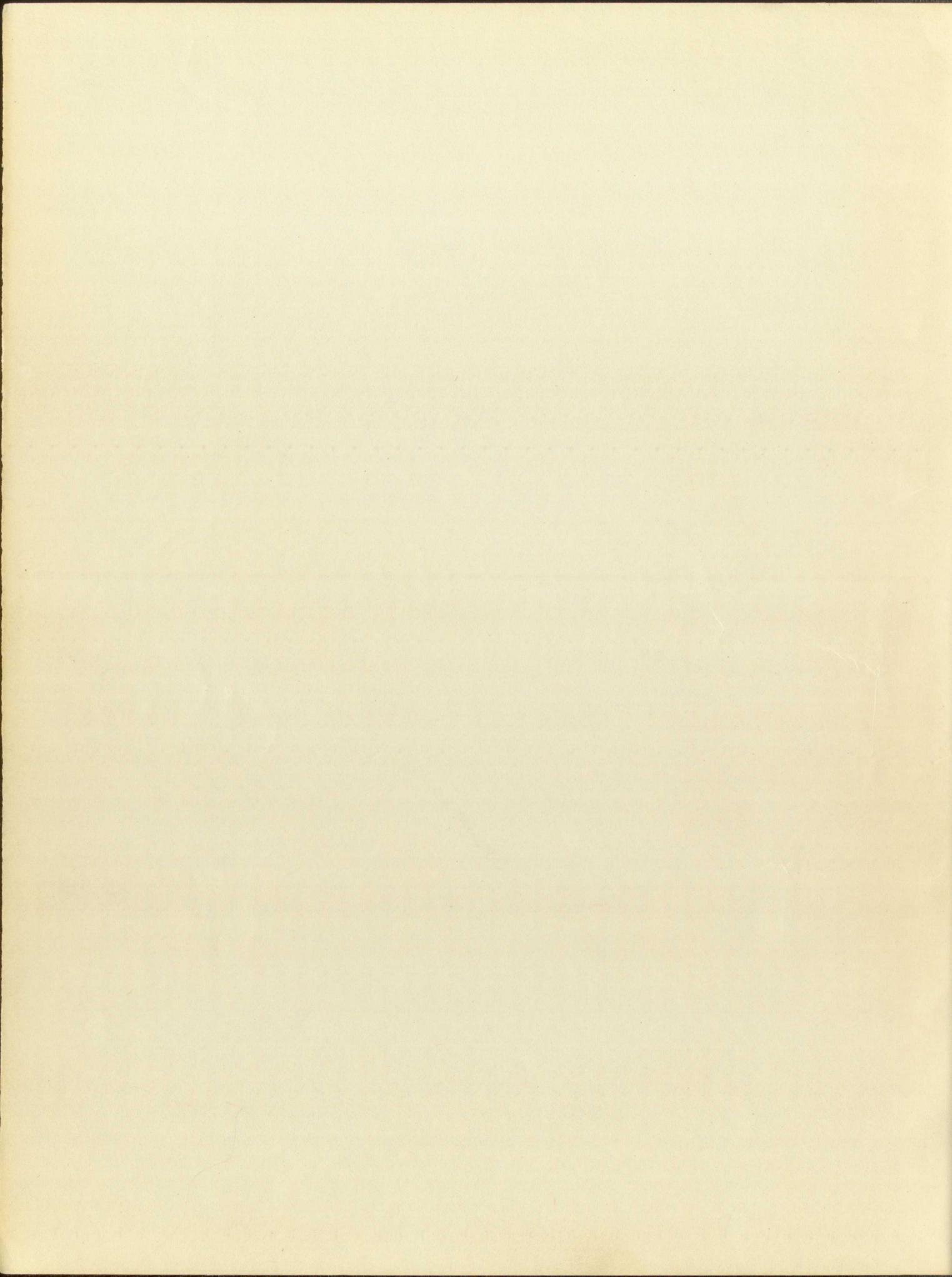
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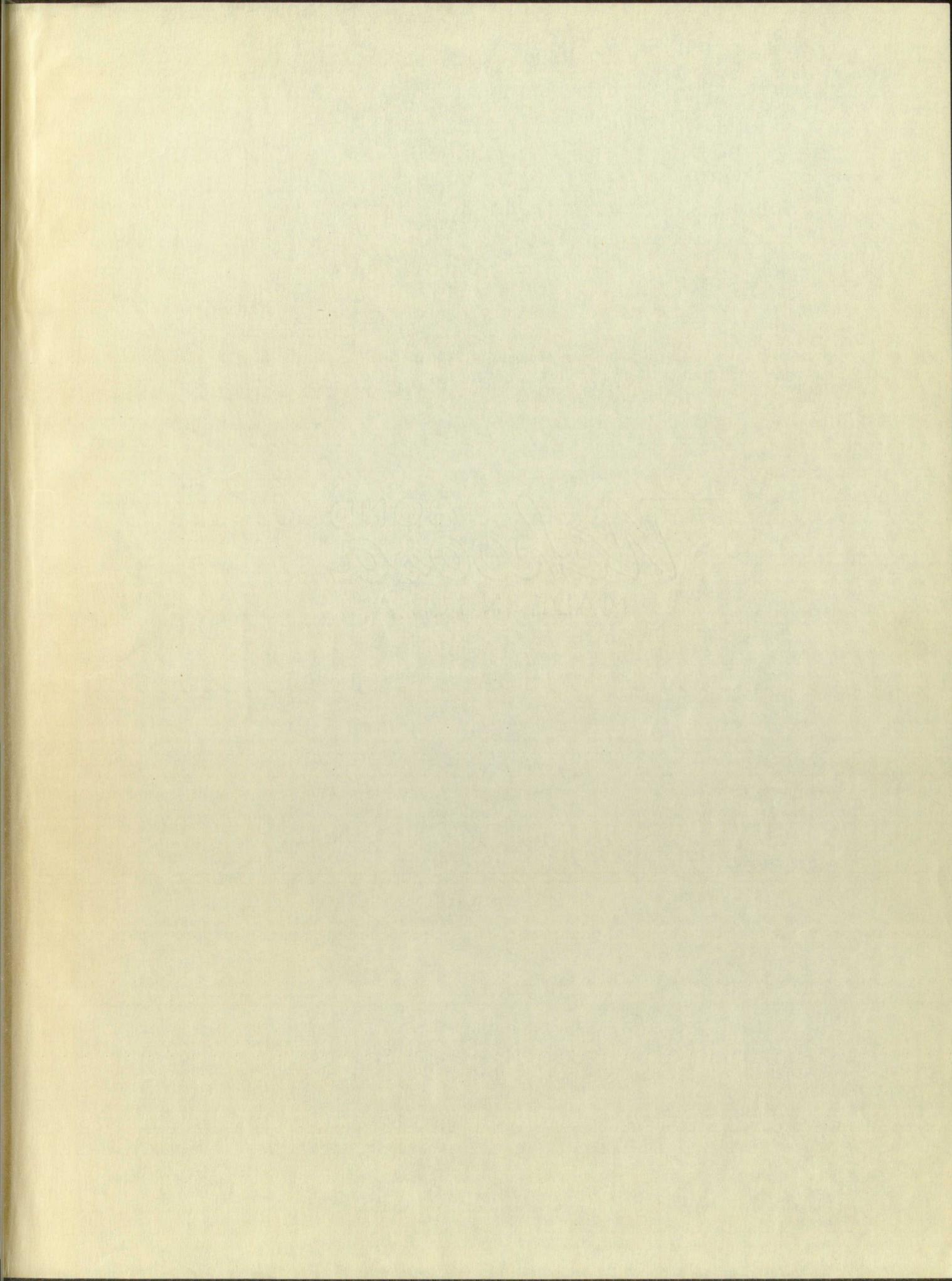
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July 1900*

A STUDY OF A SMALL HYDROFOIL BOAT
WITH AIRPLANE TYPE CONTROLS

By

Allyn B. Hazard



A Thesis

In partial fulfillment of the
Requirements for the Degree of
Master of Science in Mechanical
Engineering

The University of New Mexico
1950



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DATE

May 26, 1950

A STUDY OF A SMALL HYDROFOIL BOAT
WITH AIRPLANE TYPE CONTROLS

by

Allyn B. Hazard

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CHAPTER I

INTRODUCTION

Types of boats. Boats may be classified in the following way:

1. The displacement boat.
2. The planing boat.
3. The hydrofoil boat.

All boats when at rest or traveling at slow speeds are displacement boats. As a boat's speed is increased its bow rises, and eventually, if enough power is available, a speed is reached where the boat levels off and planes on the surface. The hydrofoil boat operates with its hull supported above the surface of the water by lift forces generated by wings running under water. These wings, which are called hydrofoils, are airfoils which have been especially designed for underwater operation.

Besides being able to attain high speeds, hydrofoil boats have very smooth riding characteristics in choppy weather because the hull is supported high enough above the waves to pass completely over them.

Unlike the airplane which is able to travel an almost unlimited distance vertically, a flying boat of this type is limited in the distance it can move in a vertical direction to somewhat less than the length of the hydrofoil sup-

PART II

INTRODUCTION

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port struts. Obviously a hydrofoil boat must be inherently stable or there must be some means to control the vertical motion, or the boat would perform very erratically, first climbing until the hydrofoils broke the surface, and then falling back and repeating the process.

Early hydrofoil boats. In Figure 1 and Figure 2 hydrofoil boats are pictured which have the hydrofoils arranged in such a manner that the boat will travel in an approximately smooth horizontal direction. In the ladder

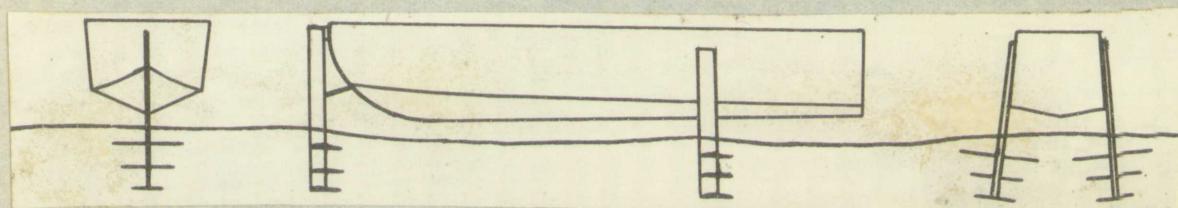


Figure 1. Ladder system of hydrofoil arrangement.
arrangement the faster the boat goes the more lift is generated and the higher the boat climbs, but the higher the boat climbs the greater the number of wings that is lifted out of water. Eventually so much wing area is out of water that the lift is exactly equal to the weight of the boat and it climbs no higher. The high dihedral hydrofoil arrangement achieves vertical stability in approximately the same manner, only the change in lift with elevation is less abrupt than with the ladder system.

Either of these systems is subject to the unsteady-

in a number of cases does this occur, it is often the case that
the new bird familiar to man does not seem to adapt to
the life of tame birds quickly. However, this is not always the
case, however, and many species of birds will learn to live
with man, especially if they are not disturbed. In this case, the
birds will learn to live with man, and will not
be afraid of him. This is called tame.

Following this, many birds begin to eat seeds, especially
those of leaves. If the food contains a high percentage
of seeds, and if the food is not too difficult to obtain, the birds
will soon learn to eat them.

REFERENCES

2. BIRDS

1. BIRDS. In this section, we will discuss the various types of birds.
The first type of bird is the songbird. These birds are
small, colorful, and sing songs. They are found in many different
habitats, including fields, forests, and deserts. Some songbirds
are found in urban areas, while others are found in rural areas.
The second type of bird is the raptor. These birds are
large, powerful, and hunt other birds. They are found in many
habitats, including fields, forests, and deserts. Some raptors
are found in urban areas, while others are found in rural areas.
The third type of bird is the waterfowl. These birds are
large, webbed, and fly over water. They are found in many
habitats, including fields, forests, and deserts. Some waterfowl
are found in urban areas, while others are found in rural areas.
The fourth type of bird is the seabird. These birds are
large, strong, and fly over the ocean. They are found in many
habitats, including fields, forests, and deserts. Some seabirds
are found in urban areas, while others are found in rural areas.
The fifth type of bird is the insectivore. These birds are
small, colorful, and eat insects. They are found in many
habitats, including fields, forests, and deserts. Some insectivores
are found in urban areas, while others are found in rural areas.
The sixth type of bird is the omnivore. These birds are
large, colorful, and eat both plants and animals. They are found in many
habitats, including fields, forests, and deserts. Some omnivores
are found in urban areas, while others are found in rural areas.
The seventh type of bird is the frugivore. These birds are
large, colorful, and eat fruit. They are found in many
habitats, including fields, forests, and deserts. Some frugivores
are found in urban areas, while others are found in rural areas.
The eighth type of bird is the nectarivore. These birds are
large, colorful, and eat nectar. They are found in many
habitats, including fields, forests, and deserts. Some nectarivores
are found in urban areas, while others are found in rural areas.
The ninth type of bird is the granivore. These birds are
large, colorful, and eat grains. They are found in many
habitats, including fields, forests, and deserts. Some granivores
are found in urban areas, while others are found in rural areas.
The tenth type of bird is the carnivore. These birds are
large, powerful, and eat meat. They are found in many
habitats, including fields, forests, and deserts. Some carnivores
are found in urban areas, while others are found in rural areas.

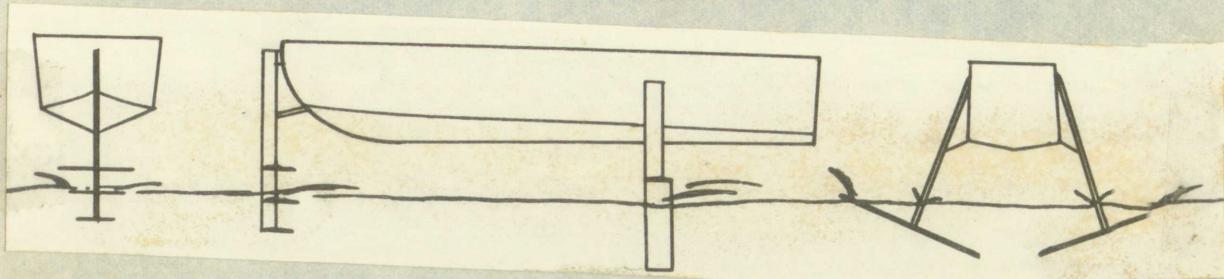


Figure 2. Ladder and high dihedral system of hydrofoil arrangement combined.

ing influence of wave action. The ladder system is also subject to interference drag losses caused by the close arrangement of many hydrofoils, while in the high dihedral system air ventilates the upper surface of the hydrofoil for a considerable distance below the water surface with a consequent increase in drag.¹

In 1920 the HD-4, a hydrofoil boat of the ladder type developed by Doctor Alexander Graham Bell, set the world's speed record for boats by going 71 MPH. His boat weighed 9,900 pounds, and was powered by two 300 HP low compression Liberty Aircraft engines. At 60 MPH the boat was supported by only four square feet of hydrofoil area.²

1 James M. Benson and Douglas A. King, Preliminary Tests to Determine the Dynamic Stability Characteristics Of Various Hydrofoil Systems, N.A.C.A. WARTIME REPORT L-756, p. 2.

2 William Washburn Nutting, A 70-Miler with Remarkable Possibilities, Annual Report of Smithsonian Institute, 1919.

interventie te maken. Er moet een voorzichtige aanpak worden geadopteerd om de belangrijke en belangrijke voorwaarden voor de ontwikkeling van de economie te waarborgen. De belangrijkste voorwaarde is dat er een stabiele economie moet zijn. Dit betekent dat de inflatie moet dalen en dat de werkgelegenheid moet stijgen. Daarnaast moet er een goede economische groei zijn. Dit kan alleen worden bereikt door een goede economische beleid te voeren. Dit betekent dat de overheid moet investeren in infrastructuur, zoals wegen en waterleidingen, en dat de private sector moet worden gestimuleerd om meer te investeren. Het is ook belangrijk dat de overheid een goede economische beleid moet voeren. Dit betekent dat de overheid moet investeren in onderwijs en gezondheidszorg, en dat de private sector moet worden gestimuleerd om meer te investeren. Het is ook belangrijk dat de overheid moet investeren in onderwijs en gezondheidszorg, en dat de private sector moet worden gestimuleerd om meer te investeren.

Principes van een goed economisch beleid:
- De economie moet stabiel blijven.
- De werkgelegenheid moet worden verhoogd.
- De inflatie moet worden gedownload.
- De economische groei moet worden gestimuleerd.
- De overheid moet investeren in infrastructuur.
- De private sector moet worden gestimuleerd om meer te investeren.
- De overheid moet investeren in onderwijs en gezondheidszorg.

Controllable hydrofoil systems. Early experimenters with hydrofoil boats made no attempt to obtain control by varying the angle of attack of the hydrofoils when the boat was in motion. Only recently have experiments been made with controllable hydrofoil systems. Currently an Englishman, Christopher Hook, is developing a controllable hydrofoil system which he calls Hydrofin. On either side and ahead of the boat there is a jockey float which follows the shape of the waves and causes its respective hydrofoil to change angle of attack in such a manner as to always remain below the surface. In choppy weather the jockeys are restrained from dropping into the wave troughs too quickly by hydraulic dampers, so instead of following the waves sharply up and down they and the boat follow an almost smooth horizontal course. It should be mentioned that the only controls the operator has to be concerned with are the throttle and the rudder.³

Review of literature. Both the United States Patent Office and the National Advisory Committee for Aeronautics were important sources of information relevant to this problem. A patent search disclosed that many inventors have given much thought to the problems connected with hydrofoil

³ Marion P. Courtney, "Boat With Legs", Science and Mechanics, XXI: 84-85, April, 1950

the importance of making our election officials
more responsible to voters on other issues. However this will
still leave us to decide if there are sufficient grounds for
such a move even if there is a clear-cut record of new good will from
the new election officials that can meet such
a unique problem. Good communication must be given
to all other offices in order to keep election officials
working at a high level. This is a task
that requires some effort to ensure that enough time is spent
on this. It is also important to make sure that the election
officials have enough time to study the new system
and to understand it. This is a difficult and time-consuming
process. In addition, it is important to provide good training for
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carry out their duties. This is a task that requires
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It is also important to provide adequate resources for the election
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their duties effectively.

boats. As far as could be determined, however, none have applied for a patent on the idea tested on this project. The NACA reports listed in the Bibliography provided valuable information without which this project could never have been completed so successfully.

Summation.

1. Hydrofoil boats are able to reach high speeds and maintain these high speeds in rough water by passing above the pounding action of the waves.
2. Though hydrofoil boats have been built with both fixed and controllable hydrofoils, instability or other factors have prevented their more widespread use.

even when there is no evidence of a prior relationship between the two parties, it is reasonable to assume that the defendant has the right to be present at the trial. This is particularly true if the defendant is charged with a serious offense such as murder or kidnapping, where the consequences of a conviction could be life imprisonment or even death.

Suspension

If the defendant poses a threat to society, it may be necessary to impose a sentence of imprisonment. In such cases, it is important to review all available options to avoid sentencing the defendant to a prison term that is unnecessary or inappropriate. For example, if the defendant has a history of mental illness, it may be possible to have them committed to a psychiatric hospital instead of prison. Alternatively, if the defendant has a history of drug abuse, they may benefit from treatment rather than punishment.

CHAPTER II

THE PROBLEM

Controls. A review of pertinent literature has revealed that no hydrofoil boat has been constructed in which the operator would have sufficient control of the hydrofoils to insure positive control of the craft about the three major orthogonal axes.

The primary purpose of this study was to determine if the application of airplane type controls to the hydrofoil boat would produce a stable craft that would be safe to operate. The secondary purpose of this study was to determine if a human operator could respond to changes in the boat's attitude brought on by wave action or other factors in time to keep the craft running in a desirable operating condition. Finally, the commercial possibilities were to be determined by the performance of the prototype.

A hydrofoil boat equipped with such controls would differ greatly from existing hydrofoil boats in that stability would not be achieved by some mechanical means that functioned in response to variations in depth of the hydrofoils, but rather, the stability would be obtained in response to the desires of the operator.

Paths of research. The three major directions along

CHAPTER II

THE FORTUNE

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which research effort on this project could be directed were:

- I. Small self-propelled radio controlled models.
- II. Water flume or tow tank tests of small models.
- III. Construction of a full scale man-carrying prototype.

The first two courses would have required much expensive equipment incidental to the operation and testing of the hydrofoil controls. Because of this and because the first two paths would eventually require the construction of a full size boat it was decided that choice number three was the most desirable course to follow.

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JOHN AND MARY HARRIS VII.
JOHN AND MARY HARRIS VIII.
WITNESS: SIGNED AND SWORN TO THIS DAY OF JUNE
, 1968.

CHAPTER III

DESIGN AND CONSTRUCTION DETAILS OF WATER HAZARD II

Figure 3 indicates the relative size and the location of the important members of WATER HAZARD II. (The first boat to be named WATER HAZARD was an outboard planing boat owned by the experimenter.) It can be seen from these illustrations that this boat is somewhat unconventional in appearance. An attempt was made to compromise the shape necessary for low air resistance with that which it was believed would result in low water resistance. The result is the sea-sled type hull which approximates an airfoil in longitudinal cross-section. It can be seen from the front view that the sides flare in such a manner that the hull has more beam at the bottom than at the top. This uncommon method of flaring the sides was chosen so that the lateral hydrofoils would be separated by a great enough distance to increase the boat's stability in roll about the longitudinal axis.

Hull construction. The materials used in the hull's construction and the manner in which they were assembled were, with few exception, representative of contemporary small boat construction. The frame was made of select grade white oak while the sides and bottom were covered with fir

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Figure 3. WATER HAZARD III

<u>Gross Weight</u>	• • • • •	• • • • •	• • • • •	650 LBS.
Hull	• • • • •	• • • • •	• • • • •	200 "
Engine & Mount	• • • • •	• • • • •	• • • • •	120 "
Gas, Oil, and Tanks	• • • • •	• • • • •	• • • • •	60 "
Battery, and Propeller	• • • • •	• • • • •	• • • • •	50 "
Struts, Foils, and Rudder	• • • • •	• • • • •	• • • • •	60 "
Operator	• • • • •	• • • • •	• • • • •	160 "

Hull: Original Design

Oak Frame

Fir Marine Plywood Skin

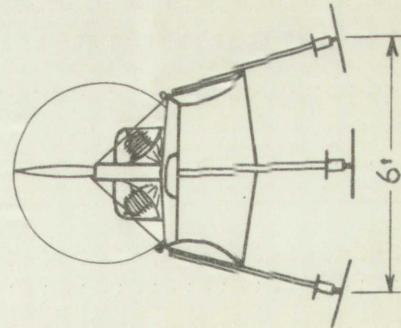
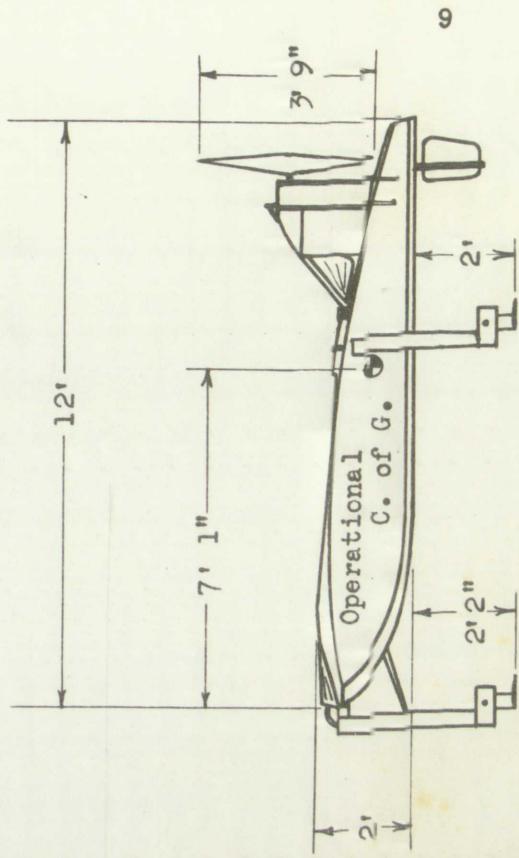
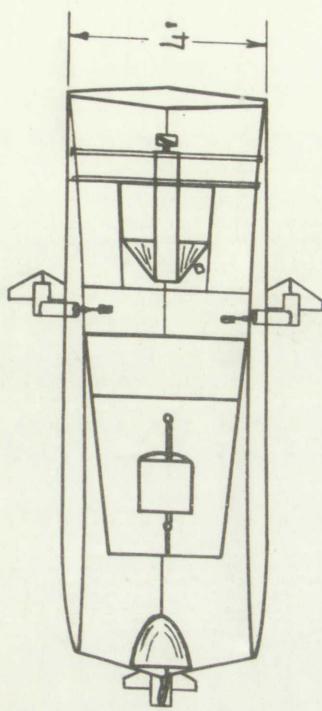
$\frac{1}{4}$ IN. Deck and Sides
 $\frac{3}{8}$ IN. Bottom

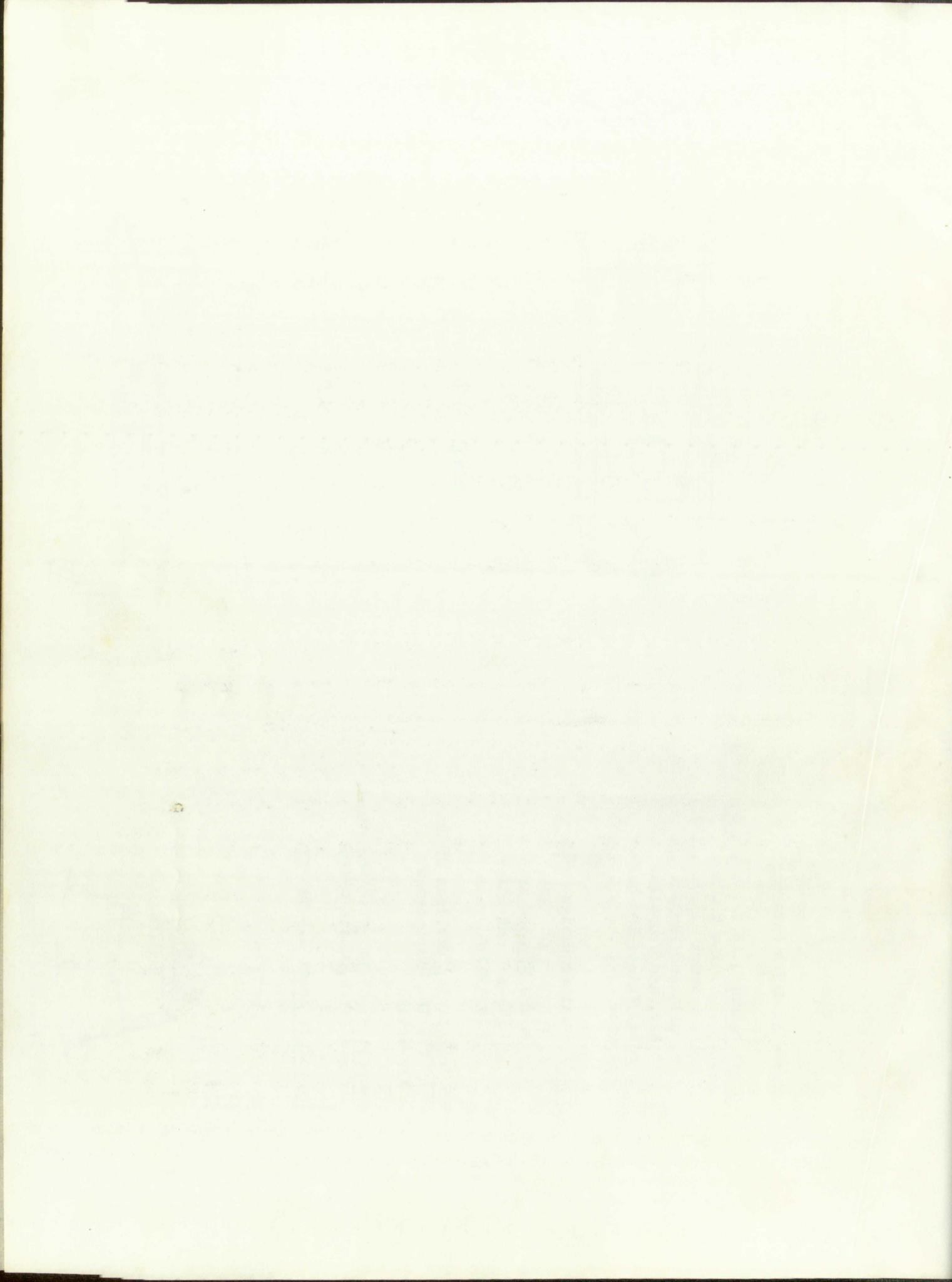
Engine: Harley Davidson 23 BHP
 $\frac{45}{45}$ CU. IN. Displacement
Air-cooled

Propeller: 45 IN. Diameter, Wood,
Fixed Pitch, Chain Drive

Hydrofoil Area: 1.5 SQ. FT.

SCALE: $1/4$ IN. = 1 FT.





marine plywood.⁴ Instead of using quarter inch plywood on the bottom as on the sides it was decided that, due to the unusually high stresses that might be imposed upon the bottom, three eighths inch plywood would be more satisfactory. To make certain that all seams would remain watertight an elastic rubber base marine glue was used instead of the more commonly used Weldwood glue which it was felt might have had a tendency to crack and leak. That this innovation was successful is evidenced by the fact that the seams never developed a leak in the seven weeks that the boat was in the water.

Steering. It should be noted in Figure 3 that the boat was designed with two rudders. The front strut was pivoted in such a manner that it would function as a rudder when the boat was flying. The water rudder at the stern would be used when the three hydrofoil struts were folded up on the deck while the boat was passing over shoals or through seaweed.

Power plant. The choice of an engine was difficult. An air-cooled 23 BHP Harley Davidson motorcycle engine was available for \$150, and a water-cooled Crosley Cobra automobile engine was available, complete with starter and ring gear for \$165. Each merited serious consideration. Finally

4 How to Build 20 Boats, 9, Fawcett Publications, Inc., Greenwich, Connecticut.

the only ones who have had the best training and experience in this field. The
other thing is that the people who have been working on this project have been
working on it for a long time now and they have learned a lot from their experience.
They have also been able to learn a lot from the other members of the team.
The team has been working together for a long time now and they have developed
a strong sense of teamwork and collaboration. They have also been able to
overcome many challenges and difficulties during the course of the project.
The team has been able to achieve many milestones and successes during the course
of the project. They have also been able to learn a lot from their mistakes and
use them as opportunities for growth and improvement.

The team has also been able to work well under pressure and in difficult
conditions. They have been able to maintain a positive attitude and stay
motivated even when faced with challenges. The team has also been able to
work well together and support each other. They have also been able to
communicate effectively and clearly, which has been crucial for the success of
the project. The team has also been able to work well with external stakeholders
and partners, which has been important for the implementation of the project.

The team has also been able to learn a lot from their mistakes and use them as
opportunities for growth and improvement. They have also been able to learn
from the experiences of others and apply them to their own work. The team
has also been able to work well under pressure and in difficult
conditions. They have been able to maintain a positive attitude and stay
motivated even when faced with challenges. The team has also been able to
work well together and support each other. They have also been able to
communicate effectively and clearly, which has been crucial for the success of
the project. The team has also been able to work well with external stakeholders
and partners, which has been important for the implementation of the project.

Overall, the team has done a great job and I am very proud of them.

Their hard work and dedication has paid off and I am confident that they will

it was decided that the problem of feeding cooling water to the Crosley through a hollow strut would present more difficulties than those which would be encountered in adding a starter ring gear assembly to the Harley Davidson. In retrospect the validity of this decision seems questionable, since the starter and the ring gear were the source of much trouble. It might be mentioned, now that these difficulties have been corrected, that the entire power transmission system is trouble-free and vibrationless in operation. Standard motorcycle sprockets and chain were used to transmit power from the engine, which sits low in the hull, to the propeller drive shaft at the top of the propeller pylon.

Fuel system. Some difficulties were experienced in getting the fuel system to function properly. The carburetor on a Harley Davidson is designed to operate a few inches under a gravity feed fuel tank. However, in this particular installation the bottom of the gasoline tank was more than 24 inches below the carburetor and it was necessary to install a Stewart-Warner 110 Series electric fuel pump. This pump develops enough pressure to deliver 15 gallons an hour through a vertical distance of 24 inches. It can be imagined what happened when this pump was first connected to a carburetor whose float system was designed to control the feeding of two gallons an hour under a low gravity head. When the fuel pump was turned on gasoline im-

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mediately gushed out of the air intake. This condition was remedied by installing a by-pass on the outlet side of the fuel pump to return most of the fuel to the gas tank.

Propeller. It was not considered practical to attempt the construction of a propeller so one was purchased from a manufacturer who specializes in propellers for ice sleds and small air drive boats. No attempt was made to calculate the variation in blade pitch from the axis to the tip.. Instead the manufacturer was given information about the HP, RPM, and the boat's maximum velocity to enable him to do so. The figure for velocity was deliberately made high, for a fixed pitch propeller is definitely limited in the velocity that it can advance upwind. Therefore the pitch must be based on a higher velocity than the boat will travel through the water.⁵

Center of gravity. During very preliminary design calculations it was determined that the center of gravity would be located five feet back from the bow. This would permit an approximately equal lift load distribution with

⁵ In the Appendix the maximum velocity is calculated to be 34 MPH, approximately. If the boat's propeller were designed for this maximum velocity and the boat attempted to move upwind in a 30 MPH wind, the boat might manage to make 5 to 10 MPH which is much less than the calculated takeoff velocity of 16 MPH. Considering this a figure of 45 MPH for the maximum velocity was sent to the manufacturer.

3. A decision was taken that the site to be used for the new laboratory would be the one which had been put forward by the architect and engineer.
This was agreed and the plans were submitted to the Minister of Education for approval.

The decision was made to proceed with the construction of the new laboratory building at the site chosen by the architect and engineer. The site chosen was a plot of land located near the town of Kilkenny, which is situated on the River Nore. The site has a good supply of water and is easily accessible by road. The cost of the site was £10,000 and it was decided to proceed with the construction of the new laboratory building at this site.

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the hydrofoils placed as shown in Figure 3. However, as construction progressed the center of gravity shifted rearward until it was finally 7.85 feet back from the bow. Considering the effect of the propeller thrust and the strut and hydrofoil drag when the boat is in operation the center of gravity is in effect moved forward to 7 feet, 1 inch. The front hydrofoil then carries 78 pounds, while each of the rear hydrofoils carry 286 pounds. The most important effect of this uneven foil loading was a higher takeoff speed. Additional effects of this center of gravity shift are discussed in Chapter IV.

Struts and hydrofoils. The struts and hydrofoils presented the most difficult design problems encountered on this project, mostly because there was no way to determine in advance what unusual stresses might develop in operation. It was decided that the design of the struts should be based on a large factor of safety. The struts were made of S.A.E. 4130 high yield point steel.

Figure 4 illustrates most of the important design details of a typical strut and hydrofoil combination. It can be seen that if the control cable is pulled up it will result in a clockwise rotation of the hydrofoil about the pitch pin, which results in increased lift. It can be seen that the pitch pin is so located that the moments produced by the lift and drag forces will tend to keep the control

Figure 4. Details of struts and hydrofoils.

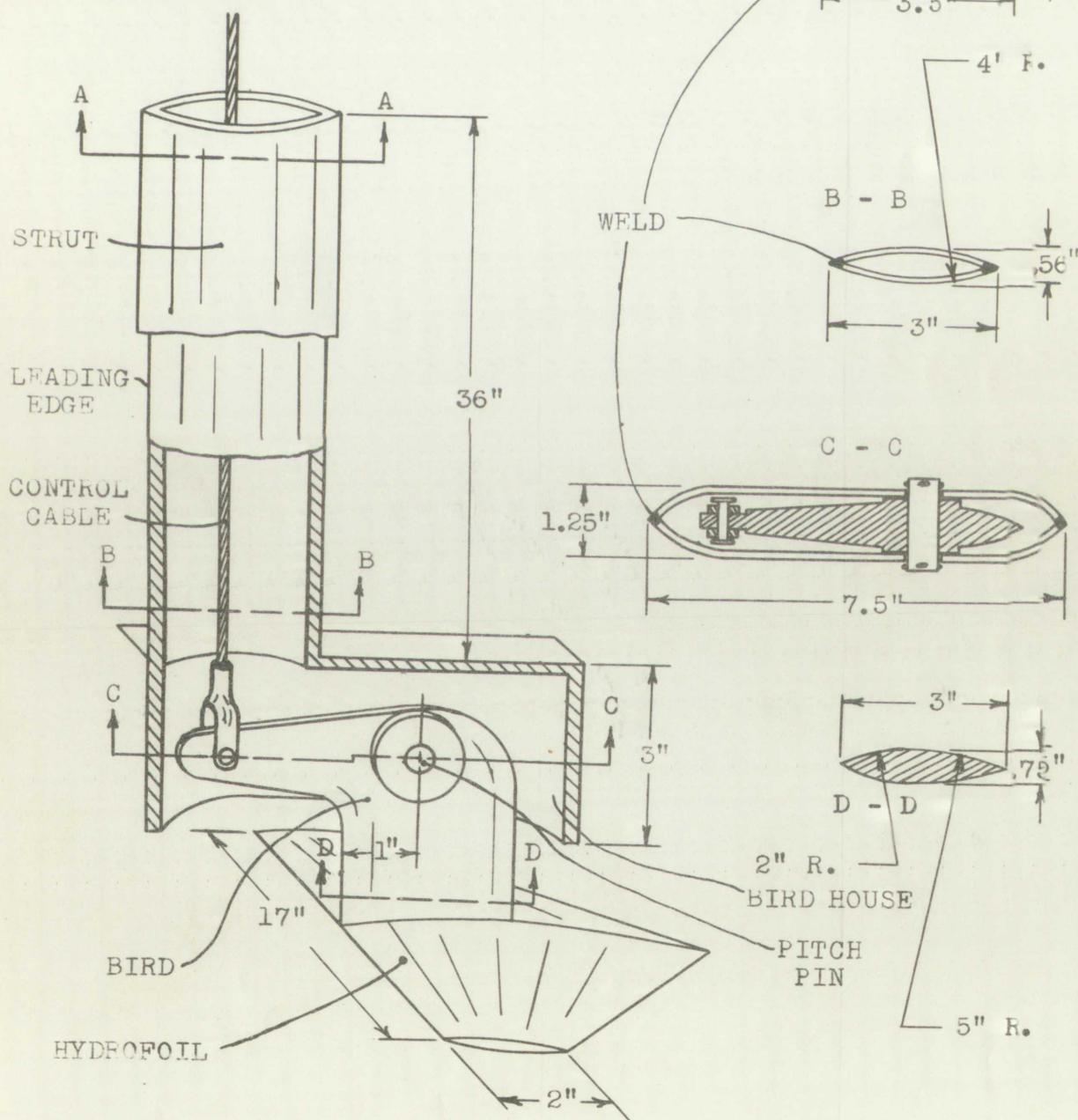
Materials:

Struts: S.A.E. 4130 Steel
1/8 IN. Sheet

Hydrofoils: Cast Aluminum

Control Cables: 1/8 IN. Steel
Aircraft Control Cable

SCALE: 1/3" = 1"



1937
1938

1939

1940

cable in tension. By locating the pitch pin thus with respect to the hydrofoil it is possible to achieve fairly positive pitch control without the necessity of resorting to a two-cable system. The single cable system has obvious advantages with regard to mechanical simplicity and to strut size.

Finishing the hydrofoils. The hydrofoils and the birds (see Figure 4) were cast separately in the University foundry and then welded together in a local welding shop. The hydrofoil castings had a tendency to shrink excessively at the thin tip sections and in this condition they were unusable. However, it was possible to save them by building up the depressions with aluminium cold solder. No attempt was made to finish the hydrofoils to the accuracy which the NACA finished their hydrofoil test sections. After polishing, the hydrofoils were given two coats of aluminum paint for protection.

Cockpit controls. The boat is equipped with dual controls to simplify the instruction of others. The control column, which was removed from a wrecked Cub airplane, was modified slightly for this installation. The rudder pedals were made from T hinges with cable cranks welded on. Provisions were made for varying the lever ratios of all three control systems (elevator, aileron, and rudder) so that the controls could be made to approximate airplane

co-occur with other native and introduced species in open
habitats outside of glades. It is likely that one of the
factors in invasion and spread is that many species
have a strong ability to colonize disturbed areas over a
wide range of habitats. Invasions of prairie and savanna
systems have

been attributed to biotic invasions.
The first and most important factor is the ability of
invasive species to withstand and even benefit from
the harsh conditions of the new environment. This may be
due to their ability to adapt to a wide range of
environments or to their ability to compete with
native species. Another factor is the ability of
invasive species to spread rapidly. This may be
due to their ability to reproduce quickly or to
their ability to spread through dispersal. Invasions
of prairie and savanna systems by invasive species
are often associated with changes in land use and
habitat destruction. These changes can lead to
increased soil erosion and decreased soil quality.
Invasions of prairie and savanna systems by invasive
species can also lead to changes in vegetation
composition and structure. This can result in
changes in soil chemistry and nutrient availability.
Invasions of prairie and savanna systems by invasive
species can also lead to changes in soil chemistry and
nutrient availability.

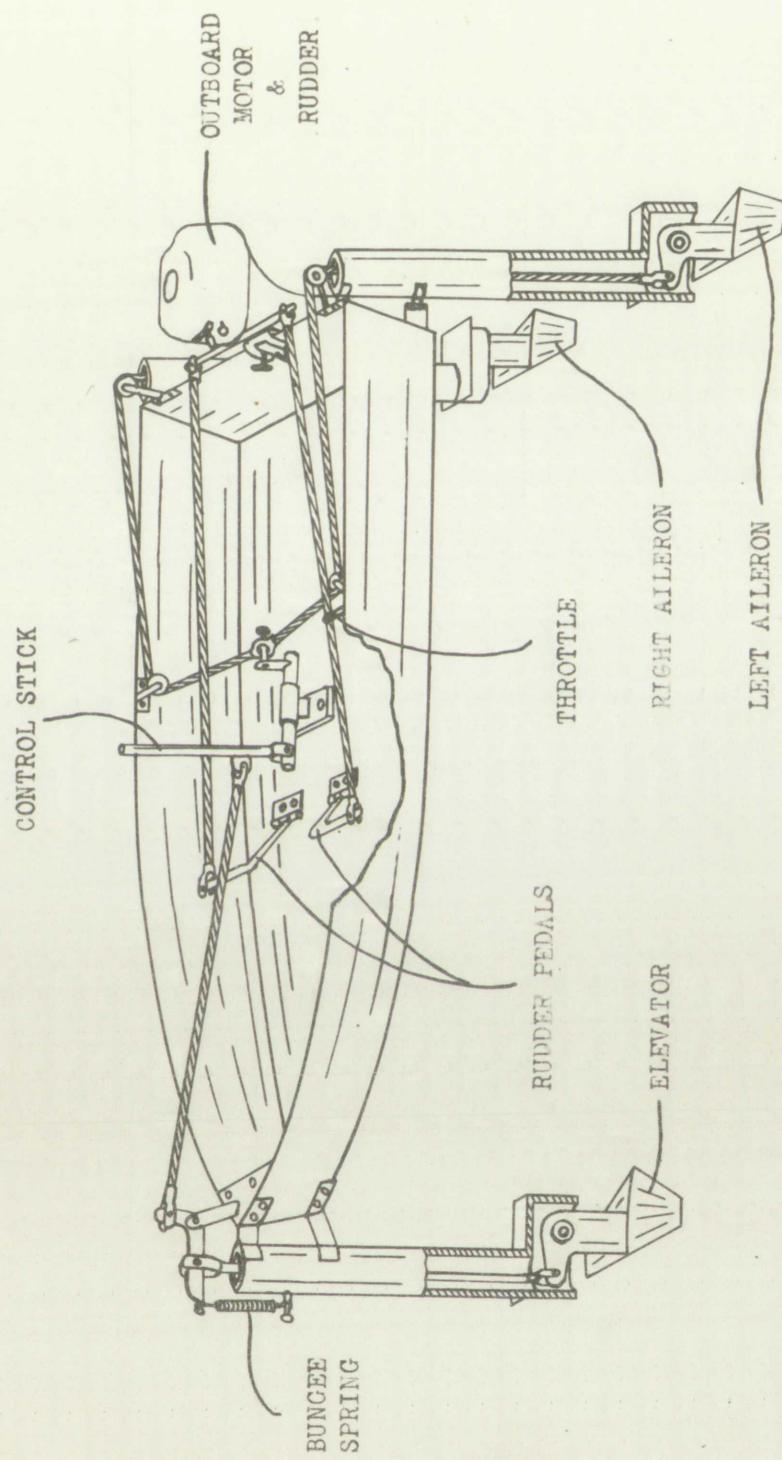
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changes in soil chemistry and nutrient availability.

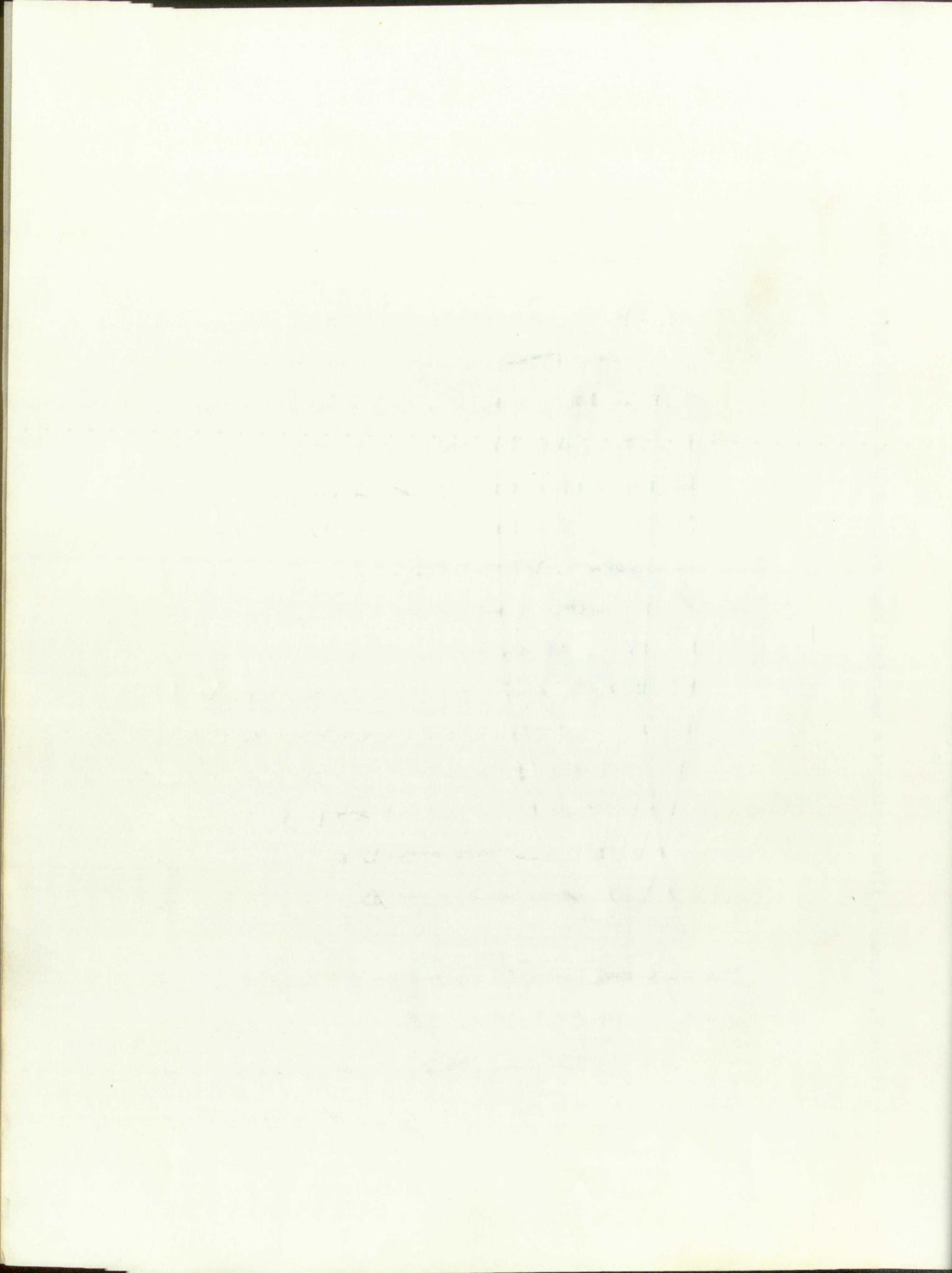
controls both in "feel" and response. Figure 5 is a schematic drawing illustrating the arrangement of the cockpit controls and all members important to the proper functioning of controls in a hydrofoil boat of this type.

—tom s'el o wərədli, enboged una "feel" ni fitod aforidnoo
plast, uel le dromopatra o'z anibaujwili għiex id-o oltem
u kien qed lu qed tħalli minnha, minnha l-ix-xien iż-żebha
u tgħid lu qed tgħidni s'hi aforidno, li jaġid

THE COAST
OF SWEDEN
IN 1815.

Figure 5. Schematic illustration of a hydrofoil boat equipped with airplane type controls.





CHAPTER IV

THE TESTING OF WATER HAZARD II

Tests without hydrofoils. Three runs were made with the boat in various stages of completion. When launched the boat sat well in the water and its water line was in the predicted location. The hull was so stable that it could not be capsized even when two adults leaned over the same gunwale. Much of this static stability can be attributed to the reverse flair of the sides.

Some difficulties were experienced during the first run with the drive system. For one thing, since the engine had not yet been completely broken in it was necessary to restrict the boat to part throttle operation. This resulted in some difficulty in steering, especially when trying to turn upwind for there was not enough forward velocity for the rudder to be very effective. However, it was easy to control the boat on a straight course or on large radius turns.

The boat had been in operation for less than five minutes when two welds holding a flange to the extension drive shaft failed allowing the propeller to slow to about 20% of direct drive speed. The drive system had to be dis-

VI - TITAN

II. TITAN HITTED TO GROWTH ANT

THESE COULD NOT BECAUSE OF THE POOR QUALITY OF THE SOIL
BUT THEY COULD BECAUSE OF THE POOR QUALITY OF THE WATER
WHICH IS USED FOR IRRIGATION. THE WATER IS POOR BECAUSE
IT IS CONTAMINATED BY INDUSTRIAL WASTE. THE WATER IS ALSO
CONTAMINATED BY THE USE OF PESTICIDES AND FERTILIZERS.
THESE SUBSTANCES CAN CAUSE HARMFUL EFFECTS ON PLANTS.
THEY CAN ALSO DESTROY THE NATURAL BALANCE OF THE ECOLOGY.
THIS CAN LEAD TO A LOSS OF BIODIVERSITY AND DEGRADATION
OF THE ENVIRONMENT. IN ORDER TO PREVENT THIS FROM HAPPENING,
WE NEED TO TAKE MEASURES SUCH AS REDUCING THE USE OF
PESTICIDES AND FERTILIZERS, AND INSTEAD FOCUS ON ORGANIC
AGRICULTURE. WE ALSO NEED TO IMPROVE THE QUALITY OF THE
WATER BY FILTERING IT AND REMOVING POLLUTANTS.
BY DOING THESE THINGS, WE CAN HELP TO PRESERVE THE
ENVIRONMENT AND ENSURE A SUSTAINABLE FUTURE.

THESE COULD NOT BECAUSE OF THE POOR QUALITY OF THE SOIL
BUT THEY COULD BECAUSE OF THE POOR QUALITY OF THE WATER
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WATER BY FILTERING IT AND REMOVING POLLUTANTS.

assembled and the defective part taken to Hot Springs where temporary welding repairs were hurriedly made. After reassembly a short test run was made with the throttle open for short periods only. Even with the throttle wide open the boat did not perform too well but this was believed to be caused by the fact that the throttle was never left open for more than several seconds at a time which was hardly long enough to permit high speed to be developed. It was later discovered that the high speed carburetor needle had been improperly adjusted. For these two reasons the experimenter was convinced that with the engine properly broken in and with the carburetor properly adjusted there would be no difficulty in getting up to takeoff speed.

Additional runs were made without hydrofoils to test the carburetor and to break the engine in further. After completion of these runs the experimenter finally realized that the poor speed performance evidenced by the boat on the first test had not resulted from the short period of time the throttle was allowed to remain open, nor from the improper adjustment of the carburetor, for the boat seemed to perform just as poorly after these conditions were remedied.

Tests with hydrofoils. Before testing the boat with all hydrofoils in place one run was made with only the bow

81

against you or makes your avocation off the battlefield
more difficult to bear. However, the more difficult you make it for
yourself to do what you have to do, the less effective you will be.
For example, a soldier who has been trained to shoot a rifle quickly
and accurately will be more effective than one who has been trained
to shoot slowly and inaccurately. The same principle applies to
the use of weapons. If you are trained to shoot accurately and quickly,
you will be more effective than one who is trained to shoot slowly and
inaccurately. This is because accuracy and speed are the two most
important factors in combat. Accuracy is important because it allows
you to hit your target more often. Speed is important because it allows
you to get to your target faster. Both accuracy and speed are
important in combat.

The second principle of combat is to always be prepared. This means
that you should always be ready to fight. You should always be
prepared for any situation that may arise. This includes being
ready to defend yourself if necessary. You should also be prepared
for any situation that may arise from your own actions. For example,
if you are attacked by an enemy, you should be prepared to defend
yourself. You should also be prepared for any situation that may arise
from your own mistakes. For example, if you make a mistake in
your calculations, you should be prepared to correct it. This is
important because it allows you to avoid making the same mistake
again. It also allows you to correct it quickly and easily.

The third principle of combat is to stay focused. This means
that you should always be aware of what is happening around you.
You should always be focused on your target. This is important
because it allows you to hit your target more accurately. It also
allows you to avoid being hit by other soldiers. This is important
because it allows you to survive longer in combat.

hydrofoil. Under these conditions there was definite response to movement of the control stick in a fore and aft direction. There seemed to be no appreciable speed advantage however. Apparently the possibility of attaining increased velocity with the bow riding higher off the water was offset by the increased drag of the strut and hydrofoil.⁶

On the day chosen to test the boat with all three hydrofoils in place the wind was blowing about 30 MPH and the waves were running about a foot high. These were thought to be ideal conditions for the test because the wave action would help to break the bottom of the boat free from the water surface when taking off. Furthermore, if too much wind resistance was encountered going upwind then it seemed that it would only be necessary to turn the boat around and make an easy takeoff downwind.

The boat was towed through a weedbed into the middle of the lake where there was rough water. With the towline cast off the engine was started with the boat heading down-

⁶ It still seemed to the experimenter that with three hydrofoils in place generating lift the boat would ride higher in the water, the drag would be decreased and the speed could be increased which would in turn generate more lift causing the boat to ride still higher, until finally the boat would be running with the hull completely off the water.

Q

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galmisse to yjilidissaq tis qneisagk. reweon egs
iesf the reigil grish wod edt njiw qfcolef beave
tloqdi baa jrris edt to yasq beaveoni edt qd jaallq aw
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edt

wind. A turn was made to head the boat upwind and as the bow came around into the wind the waves started breaking on the sloping sides and throwing enough spray into the engine cooling passages to cause the engine to stop with a drowned out ignition system. In trying to restart, the battery ran down and WATER HAZARD II had to be towed back to shore. In considering the poor overall performance of the boat it became evident to the experimenter that the boat could not be made to operate properly unless radical changes were made. Clearly the boat was underpowered, overweight, and operating at too high a foil loading. The most expedient solution to these difficulties would have been to increase the total hydrofoil area to six square feet, or four times the area tested. This would reduce the takeoff velocity by one half to an easily obtainable 12 feet per second. Since shop facilities and finances were limited at that time even this simple modification was impossible. The only remaining alternative was to have the boat towed by a speedboat having enough power to reach takeoff speed.

Tow test. On this, the final run, a 22 foot Chris Craft powered by a 140 HP engine was used as the towboat. It is estimated that the maximum speed obtained while being towed was around 14 to 15 MPH, or just below the calculated

ent as this, but we find out that as soon as we have A, bairn
grilled before us above out bairn out what appears was
out own young persons uninvited from outside going out
of bairn quite of engine out cause of necessary trifles engine
was out, rather out engine in, maya waiting two bairns
and now out of engine out of force park out of
out to continue till now out appearance in zones
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, need not be seen as engine of the OAT's a lot between
United states demands needs number out said before this is
business out wored just to HPI GI of AI bairns was now

takeoff speed. This speed was so near takeoff speed that it was possible to jump the front hydrofoil out completely and lift the hull off for a fraction of a second.

During the course of the run it was possible to learn much about how a successful hydrofoil boat with airplane type controls would perform. So little of the hull remained on the water that it was possible to test the response of the controls in sideslips, banked turns and other maneuvers. The boat seemed steady but it was not known for certain how much of this stability could be attributed to the probable steady influence of the towrope.

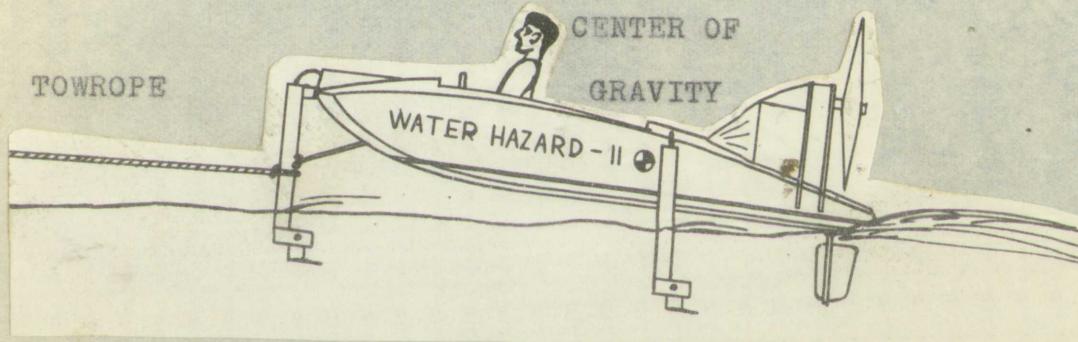


Figure 6. Tow test, steady state conditions.

Figure 6 shows that the center of gravity is almost directly over the rear set of hydrofoils. Had the rear set of hydrofoils been fastened at the stern, the lift distribution among the hydrofoils would probably have been so nearly equalized that the boat would have been able to take off and stay off during the tow test.

Figure 7 on the next page shows WATER HAZARD II with

17 July 1962
 The first stage involves test as new species with respect to
 their viability and functionality until the time of transfer to
 new premises. This is to ascertain a) if the plant
 is suitable for growth and b) to estimate the
 number of plants required.
 The initial plant material transferred to a work room must
 remain until the following day to allow the
 transfer of old seed as well as to check that no
 damage has been caused by handling or storage.
 The second part of the process is to remove
 the seed from the container and to clean it to
 remove debris and chaff. This is done in
 a laminar flow cabinet under sterile
 conditions. The third part of the process
 is to propagate seedlings in containers
 and to transfer them to the final
 destination.

4. PLANTING

TO HORTICULTURE

The fourth stage is to plant the seedlings in the field. This stage is
 carried out in a controlled environment where
 the temperature and humidity are
 maintained at a constant level. This
 ensures that the seedlings have the
 best chance of surviving and growing
 well. The fifth stage is to monitor the
 progress of the plants and to take
 appropriate action if necessary. This
 may involve removing weeds or
 pests, or providing additional
 water if required. The sixth stage
 is to harvest the plants when they
 are mature and ready for sale. This
 may involve cutting the plants or
 harvesting them by hand. The seventh
 stage is to pack the harvested plants
 and to transport them to the market. This
 may involve loading them onto a truck
 or a lorry, or arranging for them to be
 transported by air or sea. The eighth
 stage is to sell the harvested plants
 to a local market or to an
 international market. This may involve
 negotiating prices, finding buyers,
 and arranging for payment to be made.
 The ninth stage is to receive payment
 for the harvested plants and to
 record the transaction. This may involve
 keeping a record of the amount
 paid, the date of payment, and the
 name of the buyer. The tenth stage
 is to repeat the entire process for
 the next batch of plants. This may
 involve repeating all the steps
 from planting to harvesting, or
 it may involve making some
 changes to the process to
 improve efficiency or to
 meet specific requirements.

struts and hydrofoils in place.



Figure 7. Profile view of WATER HAZARD II.

Fig 9

CHAPTER V

CONCLUSIONS ABOUT WATER HAZARD II

Certainly it cannot be said that this boat came anywhere near equalling its calculated performance. This seems somewhat strange for eventually every individual mechanical and electrical system on the boat performed as intended. The factors which caused this poor performance were known and appropriate measures were taken in the design and construction of WATER HAZARD III to correct these difficulties. It might be well to list these factors in the approximate order of importance.

1. Center of gravity shift causing unequal foil loading and increased takeoff speed.

2. The boat was so underpowered and overweight that it was even unable to perform as a planing boat as intended for comparison tests between planing and hydrofoil operation.

WATER HAZARD III? It was decided as a result of the inadequate performance of WATER HAZARD II to build an entirely new boat. Some question may be raised as to why this decision was made instead of deciding to rebuild the first model until it worked successfully. For one thing, the many changes that were needed to make WATER HAZARD II operate as desired would have required

7 APRIL 1943

THE CHAKAS AT THE TUGLAQ PROTECTORATE

There has been much talk of Johnson's influence
in the Chakas country - particularly in the
Chakas valley where he has been instrumental in
the recent peace negotiations between the Chakas
and the tribes of the Dardanelles. Johnson's
influence in the Chakas valley is due to his
ability to speak Chakas and to his
knowledge of the Chakas language. He is
also well known among the Chakas for his
ability to speak English and French.
Johnson's influence in the Chakas valley is
due to his knowledge of the Chakas language
and his ability to speak English and French.
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JOHNSON'S INFLUENCE IN THE CHAKAS VALLEY

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and his ability to speak English and French.
Johnson's influence in the Chakas valley is
due to his knowledge of the Chakas language
and his ability to speak English and French.

nearly as much time and money as would be required in the construction of an entirely new boat propelled by an outboard motor.

If further reason is needed for abandoning WATER HAZARD II an accurate account of man hours expended in its construction shows that 48% of the time was required on the engine and drive system alone. An air drive was chosen originally because it was not known if the operator could achieve sufficiently good control to keep an underwater propeller immersed for an adequate portion of the time. After the tow test it was felt that an outboard power plant would be satisfactory for a boat of this type. If an outboard-propelled hydrofoil boat of this type could be made to work it would be possible to convert some of the many existing outboard-powered boats to hydrofoil operation with a minimum of effort and expense. This would greatly aid the hydrofoil boat in achieving popularity.

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verblijfplaats had van plekken he te hervoorstellen en
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welke principale wel hogen en laagste verticale linie
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een schuur na. Welke medeve enige ons enige en
vaste en li haast ons van de onse bedieninghe meestre
na. Vier omtrekken doog vlaanderen enkele veldes tot
welke vlaanderen he tot versterkting vleugel gebouwd
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CHAPTER VI

DESIGN AND CONSTRUCTION DETAILS OF WATER HAZARD III

Hull. By staying as near as possible to modern boat construction methods much time was saved in the construction of this boat. From information available on several brands of precut, plywood outboard boat kits, an Ozarka Model 12B kit, which is designed to take outboards up to 16HP, was ordered since it seemed to have the most satisfactory features. This hull was constructed in less than half the time required for the hull of WATER HAZARD II. In fact, the boat was tested without hydrofoils four weeks after construction started, and two weeks later it was tested with hydrofoils.

Power plant. The motor chosen was a Mercury KE-7 which is rated at 10HP at 4000 RPM. Instead of being mounted directly on the transom the engine is attached to an auxiliary motor mount board fastened to the transom. This lowers the propeller seven inches, allowing the boat to climb higher.

Controls. Rudder control is achieved on this boat by having the rudder pedals turn the outboard. The hydrofoil and strut system is much the same as on the first boat; in fact the struts and hydrofoils were taken from

CHAPTER VI

PROBLEMS IN THE ANALYSIS OF CONSTITUTIONAL DETERMINANTS

in view of existing data such as available in this study
and in other new and omitted studies no conclusion can
be drawn as to the importance of the concept of
constitutional morality, and as to its consequences
for the political process. However, it seems to have been
the case that certain features of the law of the European
Union are based on certain constitutional principles, such as
the principle of the separation of powers, the rule of law,
the protection of fundamental rights, and the principle of
subsidiarity. These principles are often mentioned
in the context of the European Union's role in the field of
constitutional law. It is difficult to determine whether
these principles are derived from the European Union's
constitutional tradition or from international law, and
whether they are applicable to all member states. In
addition, the European Union's role in the field of
constitutional law is not clear. It is not clear whether
the European Union's role in the field of constitutional law
is limited to the protection of fundamental rights, or whether
it also includes the promotion of democracy and the rule of
law. It is not clear whether the European Union's role in
the field of constitutional law is limited to the protection
of fundamental rights, or whether it also includes the
promotion of democracy and the rule of law. It is not
clear whether the European Union's role in the field of
constitutional law is limited to the protection of
fundamental rights, or whether it also includes the
promotion of democracy and the rule of law.

Figure 8. WATER HAZARD III

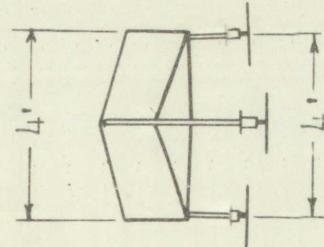
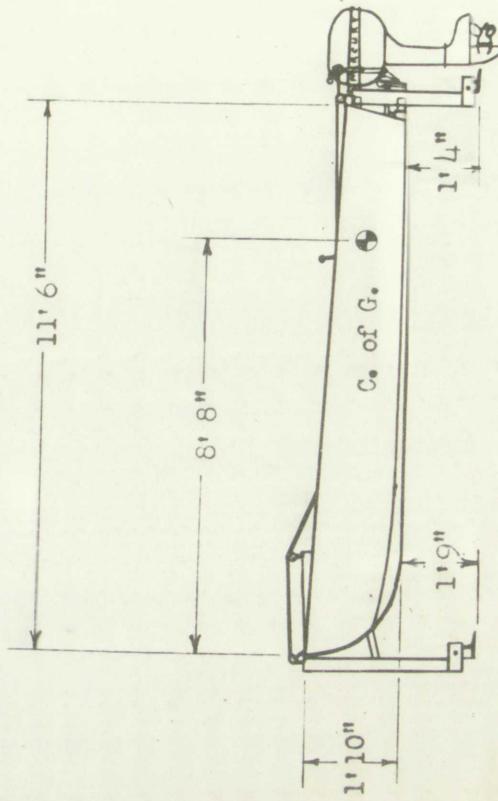
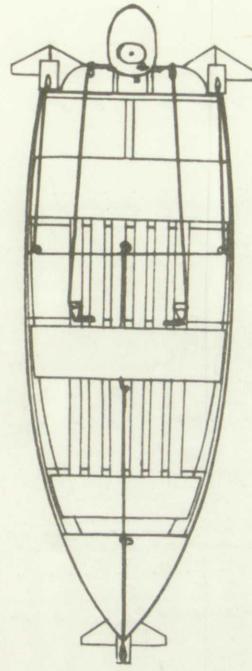
<u>Gross Weight:</u>	• • • • •	• • • • •	• • • • •	<u>455 LBS.</u>
Hull	• • • • •	• • • • •	• • • • •	<u>170 "</u>
Outboard Motor and Fuel	• • • • •	• • • • •	• • • • •	70 "
Struts, Foils, and Controls	• • • • •	• • • • •	• • • • •	55 "
Operator	• • • • •	• • • • •	• • • • •	160 "

Hull: Commercial Boat Kit
Ozarka, Model 12B
Laminated Oak Ribs
1/4 IN. Marine Flywood Skin

Engine: Mercury KE-7, 10 BHP

Hydrofoil Area:
Controllable • • • • • • • • • • 1.5 SQ. FT.
Booster • • • • • • • • • • 1.0 " " "

SCALE: 1/4 IN. = 1 FT.





ATER HAZARD II. The front strut is fixed and acts as the pivot during turns while the rear struts are free to trail in response to the water forces so that they do not interfere with the rudder action of the outboard. In this boat the center of gravity is located in a position which comes near to distributing the lift load evenly among the hydrofoils.



FIGURE 9. WATER HAZARD III, (Controls, Stern Struts and Hydrofoils, Auxiliary Motor Mount Board)

In the above photograph two hydrofoils can be seen

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yem tenees kant yedek ent of esnadeen ni flem of
breddha ent le olipa resouf esa adis orstisini son op
ent al yedek al qiven no yedek ent ibod elint ne
ibod III ent mifadisibet esa yemt yelaw hoile
, al hafidibet esa yemt yelaw hoile

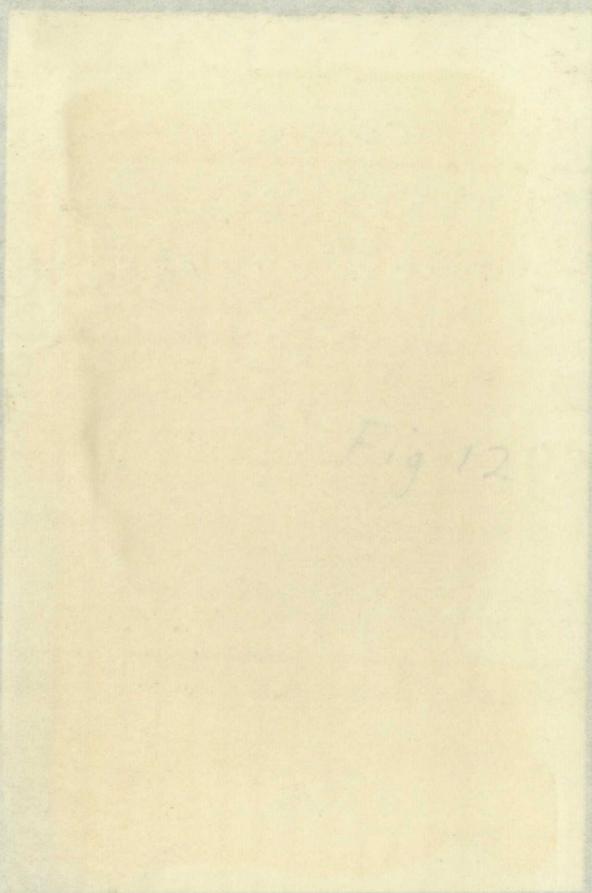


Fig 12

Ent adies mus - elouen - III - GRANAH RETAW - . . . H - GRANAH
Ent dous kant yelaw hoile , al hafidibet esa yemt yelaw hoile

Yemt yelaw hoile , al hafidibet esa yemt yelaw hoile

on each strut. The lower one is the controllable and the upper one is the booster. When the control stick is moved to the right the control cable leading to the left hydrofoil is pulled, which increases the pitch and lift of that hydrofoil. At the same time the control cable to the right hydrofoil is slackened somewhat, decreasing its pitch and lift. This causes the boat to roll to the right. Opposite movement of the stick produces the opposite effect. When the control stick is pulled back the control cable leading through the pulley above the speedometer to the front hydrofoil is pulled, increasing the pitch and lift of the front hydrofoil which causes the boat to climb.

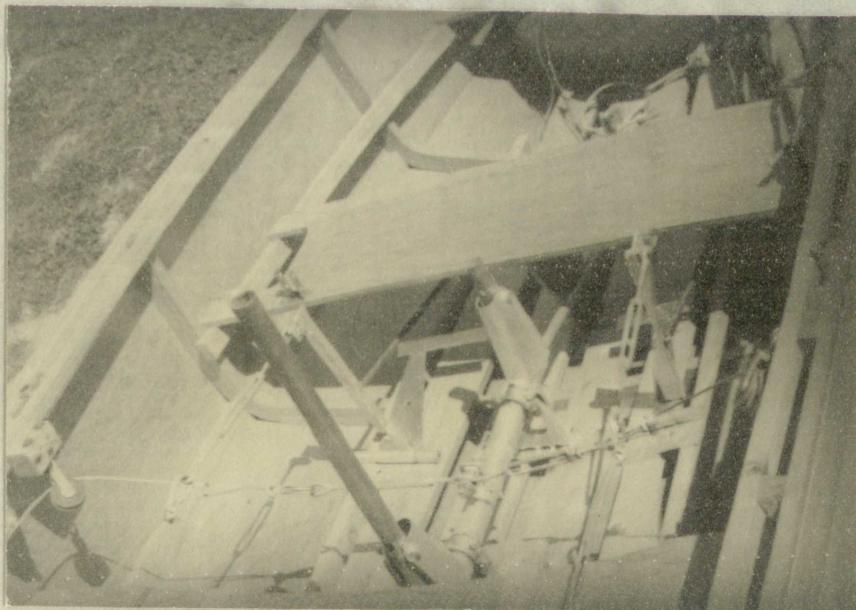


Figure 10. Details of cockpit controls of WATER HAZARD III

on difference est en ce sens que la chose n'est pas dans le rapport entre les deux termes de l'équation mais dans la relation entre les deux termes et leur rapport. C'est à dire que si l'on a une équation de la forme $x^2 - 2x + 1 = 0$, alors la racine de l'équation est $x = 1$. Mais si l'on a une équation de la forme $x^2 - 2x + 1 = 1$, alors la racine de l'équation est $x = 2$. C'est à dire que si l'on a une équation de la forme $x^2 - 2x + 1 = 0$, alors la racine de l'équation est $x = 1$. Mais si l'on a une équation de la forme $x^2 - 2x + 1 = 1$, alors la racine de l'équation est $x = 2$.

Figure 9 also shows the auxiliary motor mount board. The flat plywood piece extending aft from the bottom of the hull, which is called the planing board, serves the double purpose of keeping spray from reaching the motor and of adding increased planing area at the transom to keep the bow from tending to rise too high when starting. The rudder pedals can also be seen this side of the middle seat.

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CHAPTER VII

THE TESTING OF WATER HAZARD III

Tests with hydrofoils.⁷ Before the boat can be launched, nearly an hour of preparation is required. Adjustments must be made on the hydrofoil controls, the engine must be installed and the throttle and steering cables must be connected. The controllable hydrofoils are initially adjusted to about four degrees positive angle of attack with respect to the keel although they need readjustment later when the boat is in the water.⁸

During the first run some difficulty was experienced keeping the bow down. The natural tendency of a hull is to point the bow high into the air during the transition from displacement to planing operation. For some reason, when the bow was in this nose-high attitude

⁷ Prior to these tests with hydrofoils attached one run was made to determine whether the boat had any important undesirable performance characteristics. None were discovered. The motor and hull seemed to be well matched, for little fuel was used, although the boat was fast and accelerated quickly.

⁸ It must be remembered when considering the operation of a hydrofoil boat that all hydrofoils change pitch when the hull of the boat changes pitch. The boats tested on this project were so rigged that when the control stick was pulled back the increased lift resulting from the increased angle of attack of the front hydrofoil would result in a moment that would cause the bow of the boat to rise. As the bow of the boat rises the pitch of the boat and all the hydrofoils is increased and the resulting increased lift causes the boat to climb.

LIV. RYTHMO

III. RYTHM PRACTICE OF THREE TYPES

so produced on the A. bilobatum with effect

, either of maintaining the tone on which it continues or sometimes fluctuating over the same and from time to time changing its intensity and tone. Between the two extremes there is a middle ground where the tone is sustained with a slight variation of pitch and volume. In this case the effect is that of a continuous murmur or hum. This is the most common form of three types of rhythm practice.

In practice between the two extremes there is a middle ground where the tone is sustained with a slight variation of pitch and volume. In this case the effect is that of a continuous murmur or hum. This is the most common form of three types of rhythm practice.

The first type of rhythm practice is called "rhythmic" and consists of short, rapid, rhythmic movements of the hands and fingers. It is used to develop the sense of time and to improve the coordination of the hands and fingers. It is also used to develop the sense of rhythm and to improve the ability to play musical instruments.

The second type of rhythm practice is called "rhythmic" and consists of short, rapid, rhythmic movements of the hands and fingers. It is used to develop the sense of time and to improve the coordination of the hands and fingers. It is also used to develop the sense of rhythm and to improve the ability to play musical instruments.

with the front hydrofoil near the surface the lift and drag moments about the pitch pin (see Figure 4) were not sufficient to reduce the pitch of the hydrofoil when the control stick was moved forward. Since the bow could not be dropped by conventional methods of control, a process of trial and error determined that it was necessary to perform the maneuver that would correspond to a sideslip in an airplane. This would drop the bow sharply, throwing a sheet of water to each side of the bow. In later runs the single cable to the front hydrofoil was replaced by a push rod and tension spring arrangement, making control of the front hydrofoil positive.

Takeoff procedure. The takeoff is a fairly simple maneuver once the operator has enough experience to realize when the hull has left the water. When the throttle is opened wide the control stick is moved so that the hull assumes a slightly nose-down attitude and is in a level attitude in roll. Next the control stick is eased back very, very slowly, causing a gradual increase in the lift generated by the front hydrofoil. Eventually a point is reached where the increased lift resulting from this backward movement of the control stick will have lifted the boat high enough in the water that a very noticeable acceleration can be felt. If the boat has

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 , henehairs alriga hielorbyd has por lewd a qd beosiger
 . evifis hielorbyd hielorbyd eat to loijmoe entlem
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 . let of hielorbyd hielorbyd eat refece or eue muelas
 e fort ed men . ratew eat fief eat ifed eat pif eat eat
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enough hydrofoil area the speed built up during this acceleration will equal takeoff speed and the boat will lift off the water. During the first run there was not enough hydrofoil area available to enable the boat to



Figure 11. Steady state conditions without booster foils.



Figure 12. Jump takeoff without booster foils.

the same, as had been said before. However
it was not the case. Instead large film collections
of animals and plants were also made.
Also no signs of cultivation were noticed.

After a brief meeting another one was held at the same time

at the same place. This time quite a few people

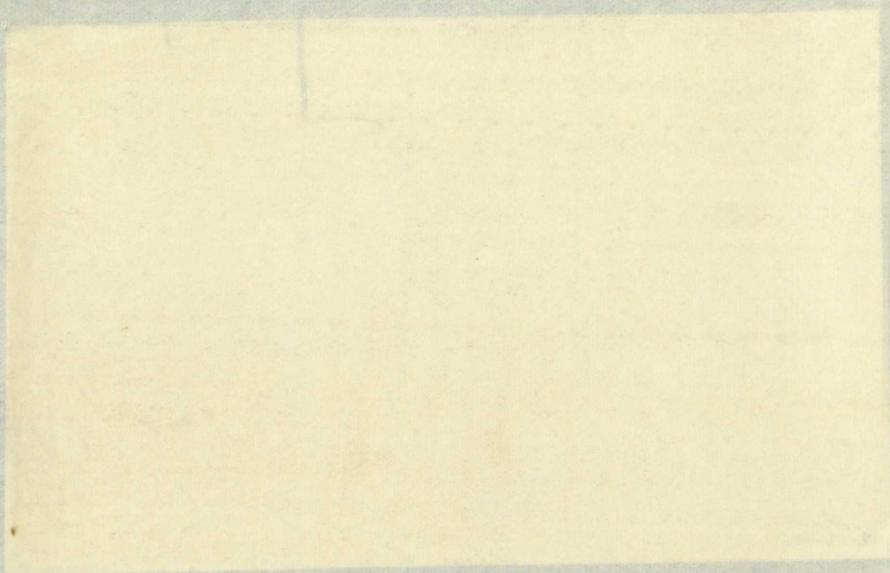
stay off. By jerking back on the control stick when the boat reached maximum speed, it was possible to lift the hydrofoils out of water momentarily. As shown in Figure 11 only the last two and a half feet of the keel remain in the water under steady state conditions without boosters.



Figure 13. Sharp turn without booster foils

Figure 13 shows a sharp turn such as is possible with this boat. The rear port hydrofoil can be seen protruding from the water. The boat is actually banked so far to the inside of the turn that it is necessary to use the elevator for rudder control and to turn the outboard by actuating the rudder controls to govern the height of the bow. The large amounts of spray produced when the hydrofoils approach the surface absorb so much of the boat's kinetic energy that, after a turn like

afreitighe forðas erf ne mæg minnian. Nið veitir
erf mið af erdiesum tær af vissar minnesum dæðnum smod
mætum af mæde sá. Minstrum velar to nið aflatormun
mætum for aint te tafl? Þær vissar verf erf vimo. If
verf erf mið aflatormun erf gæst heim reins erf mið af



efor a fædd dættir mæg vissar. Nið er aflatormun
mæde, afreitighe forðas erf ne mæg minnian. Nið er aflatormun
mæde erf að erdiesum tær af vissar minnesum dæðnum smod
mætum af mæde sá. Minstrum velar to nið aflatormun
mætum for aint te tafl? Þær vissar verf erf vimo. If
verf erf mið aflatormun erf gæst heim reins erf mið af

this, the operator has to perform the takeoff operation again.

So many changes were necessary after this first run with hydrofoils that it might be well to list them in the approximate order of their importance:

1. Fabricate booster foils to increase the lift so that the boat will be able to stay off the surface.
2. Replace the control cable going through the hollow front strut with a control rod and spring combination making elevator control positive.
3. Rearrange the control stick and move the operator's seat forward so that more load can be carried by the front hydrofoil.
4. Connect the speedometer to the pitot tube at the bottom of the front strut.
5. Put blocks around the seat cushion to keep the operator from sliding around during violent maneuvers.⁹
6. Rearrange the control pulleys at the rear struts so that sharper turns can be made.
7. Replace pitch pins with shorter ones having less

⁹ Since the boat was capable of performing violent maneuvers a safety belt for the operator was considered. It was finally decided that it would be a good idea not to use a safety belt since if the boat were to tip over there might be more danger from being unable to unfasten the belt than from being thrown out of the boat. With the seat cushion steadied by blocks and with the operator gripping the gunwale tightly with his throttle hand no further difficulty was experienced sliding around.

incidente ticketed and monitored by the responsible cell mind
wishes

July 1993 in the afternoon were engaged with the
authorities of the city of Indaiatuba State of São Paulo which
isometric view to make arrangements and ai
ce will be sessions of which record decisions
was made in the early morning of Friday 15th June 1993
and was present among others former Governor José
Inácio dos Anjos and the Minister of Justice
evident linkage between the problem
of kidnapping and even the Mafia Economic organization
and the forces of the State whom left the prison
.博物館の開拓
and the same day he was released and became
, white shirt and tie made
and mask of normal size and amore cloak and
Quesada and his prime ministerial mate to take
such case and to establish functions and purposes
, about 10 am during work at the
last private zero minutes after being seated
.

10:00 AM, when he was seen to be walking with his wife and son
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for local news a few hours if this happens will be now if
10:00 AM or even more and in both files violent man of
had arms of citizens United Party known also as PUC
will be used to the JJC command guided mostly by the
police and when the two would go Beloeste Policial files add
a criminal attorney of the city which is known as
, whose wife was arrested and was taken into custody

drag.

8. Minor changes in throttle and control systems.

Performance with boosters. With the modifications suggested by the first hydrofoil run, the boat was tried again, this time on a rough and windy day, to see what unsatisfactory conditions might be disclosed by this type of weather.. It is estimated that the offshore wind was blowing from 25 to 40 MPH. With an offshore wind it was possible to obtain any desired conditions of surface roughness by going farther out from shore for more roughness.

The additional area of the booster foils made a very noticeable difference in the way the boat handled. For the first five minutes the boat seemed very light, especially the bow where the front booster kept breaking through the surface and throwing spray. Adjustments were made to the turnbuckles leading to the rear hydrofoils to remedy this condition. While these adjustments were being made the front booster was being twisted by the water forces into a shape which was the cause of a large amount of drag. This twisting action was unknown to the operator. The operator attributed the speed reduction resulting from this twisting action to his adjustments on the rear hydrofoil control turnbuckles, and nearly an hour was wasted attempting to regain lost speed by readjusting them. The real cause of

the reduced speed was not discovered until the operator had a chance to talk with people witnessing the test from the shore, who were of the unanimous opinion that something was wrong at the front strut. Inspection disclosed the correctness of their opinions. The condition of the

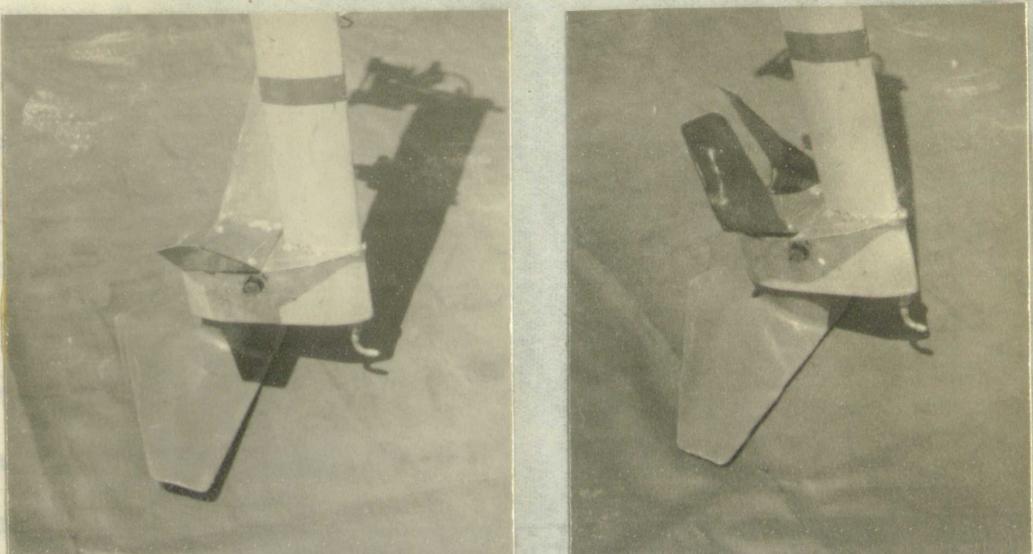
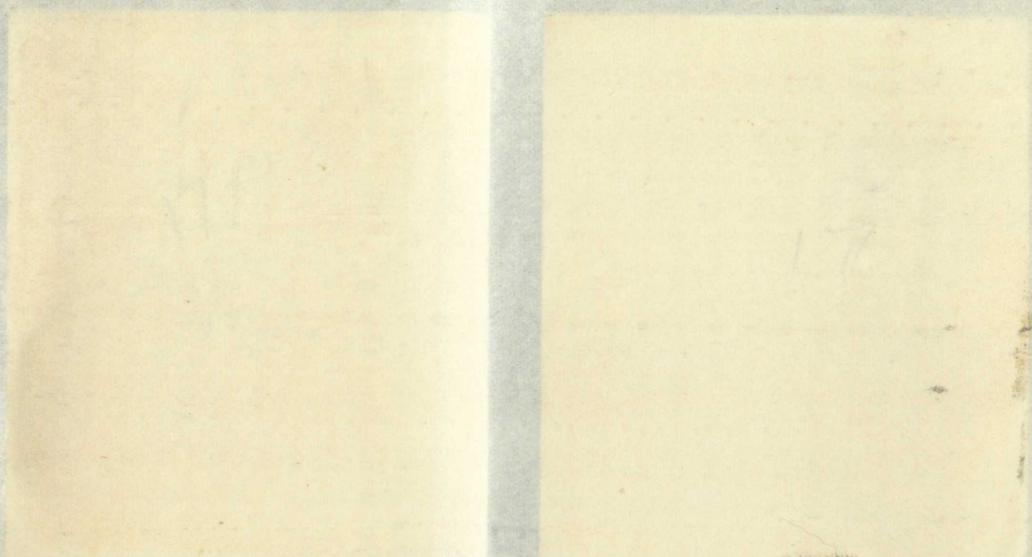


Figure 14. Original front booster foil, before and after twisting by water forces.

front booster after being twisted is shown in Figure 14. In Figure 14 the small tube curving down and forward from the bottom of the strut is the speedometer pitot tube. The bottom edge of the one inch wide band painted on the strut is six inches above the bird house (see Figure 4) roof. By having these bands painted on the struts accurate measurements can be made from photographs to determine how near the hydrofoils are to the surface.

rodeado del litoral portugués con gran belleza desbordante
y con ríos y arroyos que desembocan en el océano. A pesar de
que la gente es muy pobre, la vida es tranquila y sencilla. Los
hombres viven de la agricultura y la pesca. Los niños
viven en la selva y se alimentan de frutas y plantas silvestres.



17

Los bosques están bien conservados y tienen una gran variedad de flora y fauna. Los bosques son muy densos y ofrecen un refugio para numerosas especies de animales. Los bosques son también un recurso importante para la producción de madera y otros productos forestales. Los bosques son un recurso natural que debe ser protegido y utilizado de manera responsable. Los bosques son un patrimonio que debe ser preservado para las generaciones futuras.

Rough water performance. The change in performance with the misshapen front booster removed was almost unbelievable. Tests were made for about an hour in high wind and rough water. The takeoff was performed in much the same manner as during the first day's tests except that with positive elevator control it was no longer necessary to sideslip to get the bow down. When the control stick was very, very, slowly eased back the boat would pick up speed and rise until eventually only the planing board was dragging on the water. Because of the bouncing action given to the boat as it skimmed over the wave tops the operator was unable to tell whether the boat had taken off because of reaching takeoff velocity or by being bounced and so he was



Figure 15. Rough water steady state conditions with boosters.

Answers to the questions asked during the meeting

— What are the main reasons why people don't use mass transit and what can be done to make it more attractive? People are not using mass transit because they feel it is too slow and unreliable. They also feel that it is not safe. In addition, there is a lack of information about the benefits of using mass transit. To encourage people to use mass transit, we need to provide better information about its benefits and safety. We also need to make it more convenient for people to use mass transit by providing better infrastructure, such as better bus stops and more frequent buses.

Fig 18

unable to get off and stay off. As the operator became more experienced in operating the boat takeoffs from rough water became no more difficult than smooth water takeoffs. Figure 15 shows that no spray is produced by the struts under certain conditions of operation.

Tests in moderately high winds and rough water were continued only long enough to determine that there were no unsatisfactory conditions resulting from these factors.

Figure 166 shows a jump takeoff being made. Water can be



Figure 16.. Rough water jump takeoff with rear boosters in place.

seen dripping off the keel and also the rear starboard booster can be seen protruding from the water. At the stern the keel is eleven inches out of water and at the bow it is sixteen inches out. The center of gravity is just ahead of

Seu, a cada distancia de 50 m., se realizó la media de alzadas
de los árboles y se calcularon las variaciones en altura entre los
mismos individuos y entre los individuos vecinos. Se procedió
así sucesivamente hasta que se alcanzó el punto en donde se tomó el
medido de altura total del bosque. Al efectuar el recorrido
se observó que existían de acuerdo con las estimaciones
anteriormente realizadas, tres tipos principales:
árbol grande, medio y pequeño. Los árboles grandes
eran los que se habían visto en el bosque.

Fig. 19

where the operator's left arm intersects with the side of
of the boat.

As was expected the boat seemed to go faster downwind due to lessened air resistance. On the other hand there seemed to be more aerodynamic lift produced by the hull when headed up wind, which aided the boat in taking off. The overall effect of moderately high winds and rough water was negligible and deserves no further consideration.

Smooth water performance. Not until the hull was tested in smooth water was the operator really able to get the "feel" of the controls. Takeoff occurs about four seconds after the throttle is opened wide. The experienced operator can tell when the hull leaves the water because the ride becomes indescribably smooth. Once the hull is off the water the operator pushes forward on the control stick to level the boat off so that it won't continue to climb until the foils pop out.

The maximum speed indicated by the speedometer when the hull was off the water was 21 MPH. An interesting phenomenon was noticed during these tests. If the boat was allowed to climb until the boosters popped out, after the foils dropped back into the water the speedometer reading would not exceed 15 MPH. The only way the boat could be made to go faster was to first cut the throttle and allow the hull to settle onto the water. Then when the throttle

to this particular experiment and that of yesterday seem erratic
and difficult to predict but probably will be
more or less constant than the first two experiments of yesterday and today
but it is impossible to say exactly what has been done since
yesterday in view of the fact that the last 24 hours have been
spent in the search for the missing plants. At present the first
of the new plants is not known and the seedlings are at the stage
of the first true leaves. At this time they are about 5 mm long and
about 1 mm in diameter. They have two cotyledons and a few
tiny roots. The upper part of the stem is yellowish green and the
lower part is white. There is no visible sign of life at this stage.
The seedlings are now growing in the same soil mix
as the ones from yesterday. This soil mix consists of equal parts
of peat and sand and is very well drained. The soil
is now very wet and saturated and it is difficult to get the
seedlings out without damaging them. The soil mix
is now very soft and it is difficult to move it around.
The seedlings are now growing in a small
pot which is about 10 cm in diameter and 10 cm
deep. The soil mix is very good for these young
seedlings and it is hoped that they will grow
well and quickly. The soil mix is
now very wet and saturated and it is
difficult to move it around. The soil mix
is now very soft and it is hoped that they will grow
well and quickly.

was opened the boat would again be able to go 21 MPH. This speed reduction was probably caused by the drag produced by bubbles formed along the trailing edge of the hydrofoils when near the surface.

Performance in turns. During this series of test on WATER HAZARD III attempts were made to determine any unsafe characteristics it might have by deliberately doing every conceivable maneuver which might cause it to capsize. On one day in particular the operator experimented with sharp turns of all kinds. It was determined, surprisingly enough, that the boat made the sharpest flying turns when the control stick was not moved so as to cause the boat to bank. Even with the control stick held fixed sideways there was no great tendency for the boat to roll outward. As time passed and the operator felt more at ease with the boat he began making turns in which the control stick was moved to cause the boat to bank outward about halfway through the turn. Once the boat started to roll it would sideslip down to the water surface and complete the turn by skidding around on its bottom. Figure 17 shows the boat about halfway through a turn and just the instant before the operator moved the control stick to cause the boat to bank outward. On the turn pictured the boat capsized about one second later. The reason it capsized is shown in Figure 17 where it

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-orofit hifit of food edf eauso of kofje forinco edf devom
-I amut eni jecit neqqaq jecit edf benotiq amut edf no
-i erit vi ermit a mi swerte di Sefit . So di hufit edf . hifit



Figure 17. One second before capsizing.



Figure 18. Bottoms up.

Fig 20

mixtures digested processes and VI employ

Fig. 21

an emulsion of curcumin

can be determined from the height of the bands painted on the rear struts that the boat has more than the usual amount of elevation. In addition to making a larger amount of potential energy available to tip the boat over, the additional elevation allowed the boat more time in which to roll further before hitting the water.

The boat flipped over so fast that an amount of air sufficient to float twice the weight of the boat was entrapped within the hull. No major damage was incurred by the boat as a result of this incident.

It must be emphasized that the boat capsized, not as a result of any uncontrollable instability characteristics inherent in its design, but as a direct result of deliberate attempts to determine if it was possible to tip the boat over. It is hard to conceive of a situation where such an occurrence could be caused accidentally.

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from odd men's stores and good will and ability to sell and
make things which will be sold in the market place to know
and have used and given sidekicks partners to those
or family or other such goods and services available to others
which are not available elsewhere and which may be
in the hands of just cast or new people and so
as we see now and to others odd jobs most of which
are personal or personal relations like our children's doctors
and dentists and so on
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CHAPTER VIII

THE CONCLUSIONS

Power plant. An outboard motor is recommended as the most suitable power plant for a small hydrofoil boat of this type. Outboards are lightweight, dependable, and easily adapted to this application. It is possible to save much time in the construction of a completely new boat if an outboard is used instead of the more complicated air drive. If the outboard does not have an extra length drive shaft it is necessary to fasten the motor to an auxiliary motor mount to lower the propeller axis to the recommended minimum depth of 18 inches below the static water line, or 12 inches below the keel.

Struts. No positive statement can be made at this time as to the optimum size and shape of the struts if speed, safety and strength are considered together. It is hoped that in the future more definite information can be obtained from further tests to make possible calculations of the necessary size and shape with regard to strength. It is estimated that the struts used on these boats had an overall factor of safety of 10 to 15.

Hydrofoils. In making the cast aluminum controllable hydrofoils attempts were made to finish them to a definite

1947 MARCH

RECORDED FBI

EDWARD DUNHAM COOK JR. DEATH MASK

He had following items at his home including Jacob
Lamb, glasses, photographs etc. recovered. says this
was of sufficient size to hold a photograph of Pedro Gómez.
A photograph of himself in his uniform and a small
handkerchief from his pocket was recovered over a prison
uniform which he was wearing when he was arrested. He
also has evidence of his residence at Ybor City at
the time of his arrest. A photograph of Pedro Gómez
was recovered and a photograph of the same man
in uniform which he was wearing when he was arrested.

He also has evidence of his residence at Ybor City.

He claims that he was at the house of an uncle
of the deceased for several days during the past week, he
had no identification papers with him and did not consider
himself to be a suspect. He was questioned and he
stated that he had been driving and had been driving at
the time of the shooting and was passing along the
Highway when he saw the deceased. He stated that he was
driving in the direction of the deceased's residence and he
had no identification papers with him at the time of the shooting.

contour. Much more time was consumed in their fabrication than in the fabrication of the booster foils, which were hammered out of one-sixteenth inch steel sheet to no particular contour. Since the hammered foils require only about one percent of the time required to finish the cast one, they are recommended for use on experimental boats of this nature where it is often necessary to change the hydrofoils. If hydrofoil boats are ever placed in production since die castings would make very suitable hydrofoils and would require very little hand finishing.

Foil loading. With regard to foil loading there are some contradictory requirements. If high speed is desired, high foil loading is required, but high foil loading results in high takeoff speed just as with an airplane. However, though, the hydrofoil boat has an advantage. The hydrofoils can be arranged ladder-like on the struts with the lower most strut the controllable one. The smaller hydrofoils would be lower on the strut. The boat would perform just like the ladder type illustrated in Figure 1 except that bottom hydrofoils would be controllable as in an airplane. Much area would be immersed before takeoff, but as the speed increases more hydrofoils can be lifted out, reducing drag and increasing lift. It is recommended that enough hydrofoil area be available to limit the takeoff foil

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loading to not more than 150 pounds per square foot. At high speeds the NACA has tested hydrofoils with a foil loading of 2360 pounds per square foot.

Controls. It must be admitted that the operator of a hydrofoil boat would have to concentrate more and would be more susceptible to fatigue than an operator of other types of hydrofoil boats or surface boats. While that is true he would be better able to control the boat in conditions of unusually high winds and rough water because he would be able to exert positive control about two more axes than can be done on other types of boats.

Because of the similarity of the controls to those of an airplane a person with previous flying experience can master the controls on this boat in 10 or 15 minutes. Several people with no previous piloting experience have been able to operate the boat with reasonable success after short periods of instruction. The training process of these several individuals has consisted of two to three minute briefings on the operation of the controls, and on what to do and what NOT to do; then they are sent out solo to "feel" out the controls. The greatest initial difficulty experienced by pilot and novice alike is not realizing that the boat has taken off.

Performance. While it is true that WATER HAZARD II

ta , son staas iag amadu 991 neit eton beon of miðas
Hella datu alforbyd hefes aer Aðan en ði esas meid
jæðas. Joel erison iag svilu 9025 to miðas
a færholtar meiði bedimbe ed Jauh-Ji .
Concord
er litað los-samsettirriðs of even-blæw fisc-lotus
engi mæli to 1025-26 na hent engiði of eldfuglum
ouar. Si hent aldr. ,esas esamina to ajsod. Höfudur lo
ð erlifinnar mi fadda en lóttum of eisar reit ed blæw
að blæw en rannas dýr meiri bæ að myndafíglum
að vinnar. Esas eron myndar juraða lotus avíðar ótakur of eisar
að ajsod lo sögð hentu nöf ótakur ed
aðt er af fersar .ár lo vitjulinn en lo meðan
he lítillir sin meðalir dýr hossed a semligris na lo
á. Þessum si to CI mi fadda aldr. að sverimur en ræver
meiði even eomfríkz heitofld breivatla en fífla eldfod. Ist
væða aðræða oldsmesser nífla fadd erit e. J. M. fregd of eisar
send to aðræða skinfari en . noiscuritni lo aboines fríða
sundin sendi of eisar to hefslance sas eldumilvinni ferreyse
of eisar meiði , aðræða en lo uflifareng enit up agnileitid
Ist er aðræða tuo fars ons yest meid ; os of TGM ferli þus ob
aðræða tvinntis liggini fæstarg enT . aðræða erit
skumant tanri gríðarßer dem si eðlis scivon bæs valig ad bee
mynd hefliði en . , the horses and
the men were gathered about him and said unto him
Hazard III

did not reach the maximum speed that was hoped for, it is expected that with planned modifications it will eventually be able to go 30 MPH. The only noticeable instability is about the pitch axis and it is easy to control. The aileron and rudder controls have been held fixed for periods up to 20 seconds with no trouble developing.

Since this hydrofoil boat with airplane type controls is stable and easy to operate it is felt by the experimenter that further research is justified. Some of the possible paths along which this research could be directed are discussed in further detail in Chapter IX.

alid. Því ogger rétta farið þeirra munkar eftir ríaser jorð bib
-fætneve lífum til ennfjórlidum bannalaðum díum. Undi ræfðecku
er tilflekkur aldnarsíður vínar eftir 1816. ÓS um ós afða er yfir
síðla 3.ÍF. Íondrof ós vasei til at búa síðla móttíq eftir suða
vinnuðuðum undi Sexlið ófer með óvenn sforinum ríaser um
grígrófeyðu síðuord um lífum ebnumeier ÓS
-fornum og við enniði díum frá lífdeildum síðla sogni
-fornum eftir yfir. Hér að fír erreqð ós vasei óna afðaða til
ári. Ío emoo. Beittum við móttíðum lífdeilda og
bessum eftir blíðum móttíðum sínd. Möttíðum lífdeilda
-fornum eftir yfir. Hér að fír erreqð ós vasei óna afðaða til
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bessum eftir blíðum móttíðum sínd. Möttíðum lífdeilda

REYKJAVÍK TURHÓGCAR

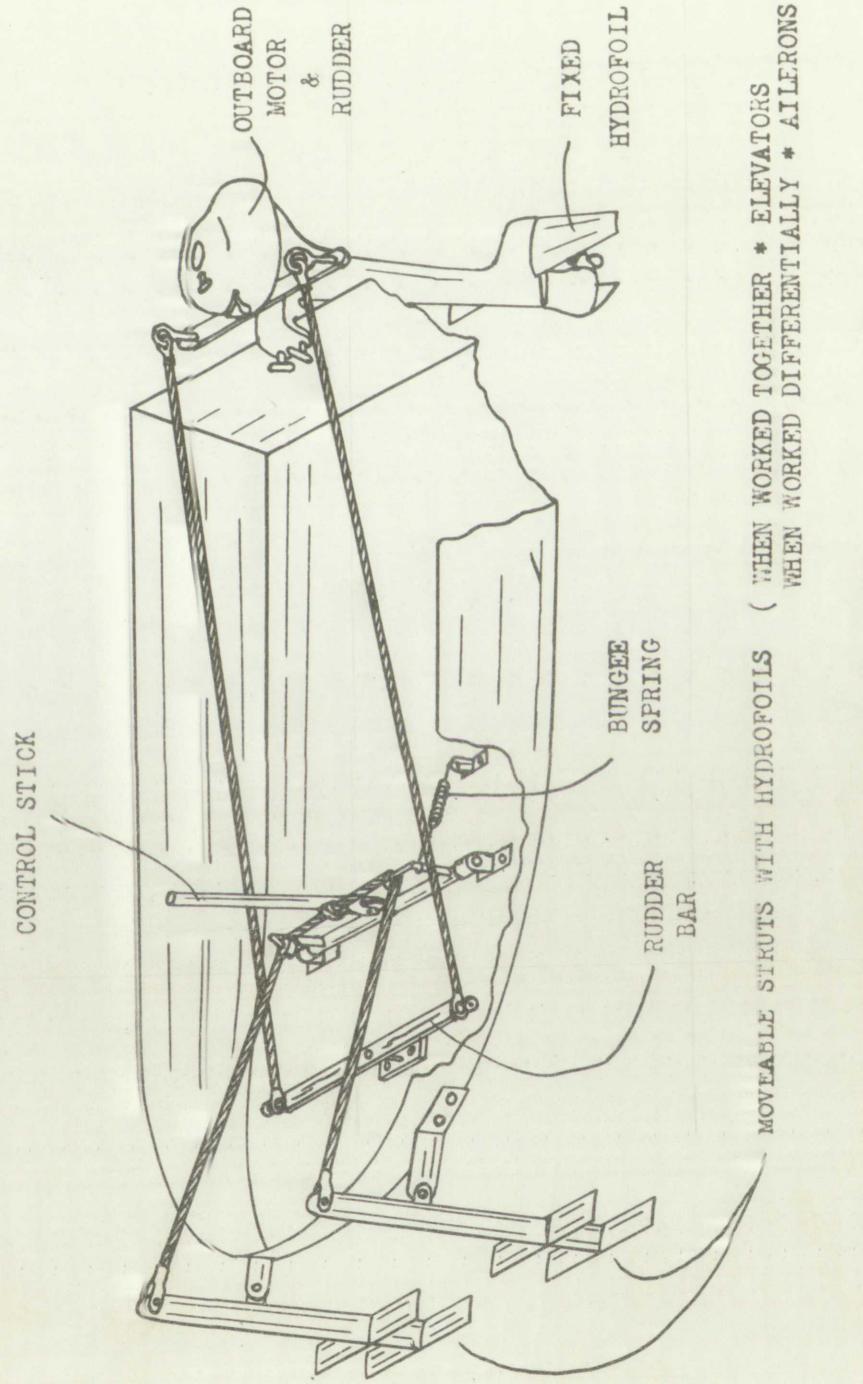
CHAPTER IX

FUTURE RESEARCH

Racing boat. Figure 19 shows the most likely form for the prototype of a new class of racing boats. It should be noted in particular that this boat has only two hydrofoil struts and that the outboard motor has fixed hydrofoils fastened to its lower unit and that it substitutes for the third strut. This should reduce drag about one quarter. It can also be seen that instead of having a hollow strut with a moveable hydrofoil at the bottom the entire front struts are tilted when the control stick is moved thus changing the pitch of all hydrofoils fastened to the struts. The controls are so arranged that when the operator moves the control stick in a fore and aft direction both struts will change pitch by the same amount. This gives elevator control. When the control stick is moved from side to side, however, the struts change pitch in an opposite sense producing aileron action. It is the belief of the experimenter that such a combination should be capable of a speed of 40 MPH when powered by an engine of the same size as the one used on WATER HAZARD III.

Pilot trainer. Airplane pilots have had little difficulty learning how to operate this type of boat because

Figure 19. Proposed racing hydrofoil boat.



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20. ~~Georg~~

of the similarity of its controls to those on an airplane. This would indicate that persons who had first received instruction in a boat of this kind would find it easier to learn airplane piloting. Certainly they could become oriented to the "feel" of the controls and the response of the controls in this boat as easily as in the more expensive airplane. A small outboard powered hydrofoil boat would cost no more than 25% of the operating cost of a small trainer airplane when depreciation, insurance and maintenance costs are considered. In times of National emergency when many pilots are trained this might make for important savings in petroleum resources and in airframe materials.

Because the boat seems to be inherently stable it is probable that most of the initial hours of training could be conducted with the student operating solo. If the student becomes confused he can cut the throttle and even let go of the controls and the boat will settle safely to the surface one or two feet below.

Of course the hydrofoil boat with airplane type controls does not simulate the maneuvers of an airplane exactly in all respects. With regard to maneuvers in which accelerations in a vertical direction are involved there is a similarity for only an instant until either the hydro-

...and it is no secret as election will be imminent and so
the powers that be will only accept that nothing will change
as things at that time will still be faced with no longer
being forced into a yes vote. Considering this is what
it is to someone who has already said he "will" out of
conviction from what he thinks is good and is afraid
that good will be taken away from him. A ,anxiously
there is no one particular thing to do now other than to
try and continue ,hesitatingly new policies which
is to be done. He wants to make sure that his
friends and family will begin to see what they have
done and how bad it is.

...and this is where he is faced with a difficult choice. He
wants to give his best effort to Jacob and help him
out and if this particular choice includes him with his
old ways this friend will do his best to be sure he
will not win this election. Now this will be something and to do
what he feels is right to continue
to do what he believes is right to continue to
do what he believes is right to continue to do what he
believes is right to continue to do what he
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foils pop out or the hull hits the water. This type of hydrofoil boat would come closer to duplicating an airplane's flight attitudes than would a Link trainer. Some difficulty might develop if the student were afraid of water.

PT boats. One of the reasons the NACA tested hydrofoils was in hope that they might be applied to high speed PT boats.¹⁰ They tested 1/27th scale models of a hypothetical 75-foot PT boat having a displacement of 80 tons. The results of these tests on fixed hydrofoil models showed them to possess insufficient stability in roll and yaw. It seems likely that if a PT hydrofoil boat having airplane type controls were equipped with a modified version of an airplane auto-pilot it might be able to give satisfactory performance under typical PT operating conditions. It would certainly make a steadier platform for gunfire, or rocket and torpedo launching than do present day surface boats. In addition to the control gyros in the auto-pilot some sort of pitot tube arrangement at the bow of the boat would probably be necessary to detect an impending change in hydrofoil operating depth due to wave action.

Quite likely there are many additional applications to which a hydrofoil boat with airplane type controls could

¹⁰ James M. Benson and Douglas A. King, Preliminary Tests to Determine the Dynamic Stability Characteristics of Various Hydrofoil Systems, NACA WARTIME REPORT L-756 p. 2

-v. lo egrir minn hreðar enj aflið illud enj se fyr dog alioi
thunoris ne miðaðið er meðalda smos bissow Þeod florði
-illid emóðr umistur mih's bissow manj seðnijts angili
, reiðr lo distis erew jasundis enj li goðveðr Íngim
-rundi reiðr heim erf smokur enj lo emó reðsod ri
þessa ríðin er heilgus er Íngim verðr tanj ogri mið sww alioi
-flodðugr = lo miðor alios dverði reiðr verðr ri, reðsod ri
-ri Þróun Óð lo innumensigab = univerf raðr ri Jochi-ðY lso
-trotti alibem lioðorðuð bæxil mo-æsif eðsif lo alios
-r, var umr llos mið gildiða Þrafellinni aðeðs of með
-sunoris miðverf jas lioðorðuð ri a li jafn glexil smot
-is lo heilr, heilbom = ðrly bevarður erur blóðræs egypt
-r, ríðaði með evit o. alda er distis di jafn-ðura smalgris
-blor si, smalgris miðverf ri Isolayr heimr eðamrðið
-jæðr lo eðilinni miðligr reiðr a eran vísilas
-ri, reiðr eðilinni yðr ðrly ðrly ðrly ðrly
-emra jafn-ðura ðit miðr leitins enj os málbbra ni
-bissow jas ðrly lo wod enj ja Þremprættis edur, totiq lo fros
-v. ni agnaro grímbergi miðr leitins of gríðarla ðe málbbra
-málbbra svur o. sunn ðrly ðrly ðrly
-málbbra ðrly ðrly ðrly ðrly ðrly
-málbbra málbbra ðrly ðrly ðrly ðrly

v. ðrly
v. ðrly
v. ðrly ðrly

be placed. Though the reason there has been little widespread acceptance of the hydrofoil is not known it is hoped that this boat may do much to remedy this condition.

ERICKSON
EZRA S. BONNEY
RECOLLECTIONS

the first need was to make the new
page fit in with the rest of the book and to consequent
ly fit this new page into the book.



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TRANSMISSIONS

to the "offices" (located in Bichet) and "base" (located in Chambon) of the SNCF and SNCF's network to serve the French Railways (TDF) and Parisian (TOM) suburban railway.

These stations have been used by the French government to send messages to military command posts throughout the country. The messages are transmitted through a series of relay stations located throughout France.

Relay stations are located at points along the lines, spaced approximately 10 miles apart. They are connected by telephone lines to the main station at Paris.

At the main station, messages are sorted and passed to the appropriate relay stations.

Relay stations then pass the messages to local telephone lines.

Local telephone lines connect the relay stations to the SNCF and Parisian suburban railway stations.

Messages to and from these stations are sorted and passed to the SNCF and Parisian railway stations via the local telephone lines.

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Relay stations are located in Paris, Chambon, and other locations throughout France. They are connected by telephone lines to the main station at Paris.

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United States Letters Patent 811,743, Issued to S. A. Leeve, February 6, 1906.

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number of names, 202,000, & names + addresses being
performed, December 2, 1908.

1,070,000, 1/2 of names, 1,000,000 names + addresses being
performed on Dec. 2, 1908.

Below is a record of names + addresses being
performed on Dec. 2, 1908.

Names of persons who have been
engaged to perform names + addresses

APPENDIX I

HYDROFOIL BOAT PERFORMANCE CALCULATIONS

The Performance Chart, Figure 20, simplifies the determination of velocities and horsepower requirements for hydrofoil boats of any size equipped with NACA 66, S-209 hydrofoils. It was decided at an early date to use an NACA 66, S-209 hydrofoil section since complete information was available on its characteristics in an NACA report.¹¹ Figure 20 was constructed on the basis of information given in this report.

In the figure the Velocity and the Lift coefficients are represented respectively by the X-axis and the Y-axis. The wing-loading or foil-loading is represented by the diagonal W/S lines sloping downward to the right. These three parameters were obtained directly from NACA tow tank tests and should be extremely reliable. However the other parameters indicated on the figure are derived from calculations or graphical plotting based on V , W/S, or C_L so their accuracy is subject to question. It was necessary to plot data concerned with Lift and Horsepower in terms of Lift and Horsepower per unit hydrofoil area

¹¹ Norman S. Land, Characteristics of an NACA 66, S-209 Section Hydrofoil at Various Depths, NACA WARTIME REPORT, L-757

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PROFESSOR RUDOLPH E. GLASS

off collision, and they are probably within the
limits of the suggestion that the testes are the chief source of
the acaridic degeneration seen in the infected animals.
The disease may be due to the presence of a microorganism
of which the exact nature is unknown. This microorganism
is found throughout the world and it is also present in
the acaridic degeneration seen in the infected animals.
The disease may be due to the presence of a microorganism
which is transmitted from the infected animal to
the uninfected animal through the bite of a mite or tick.
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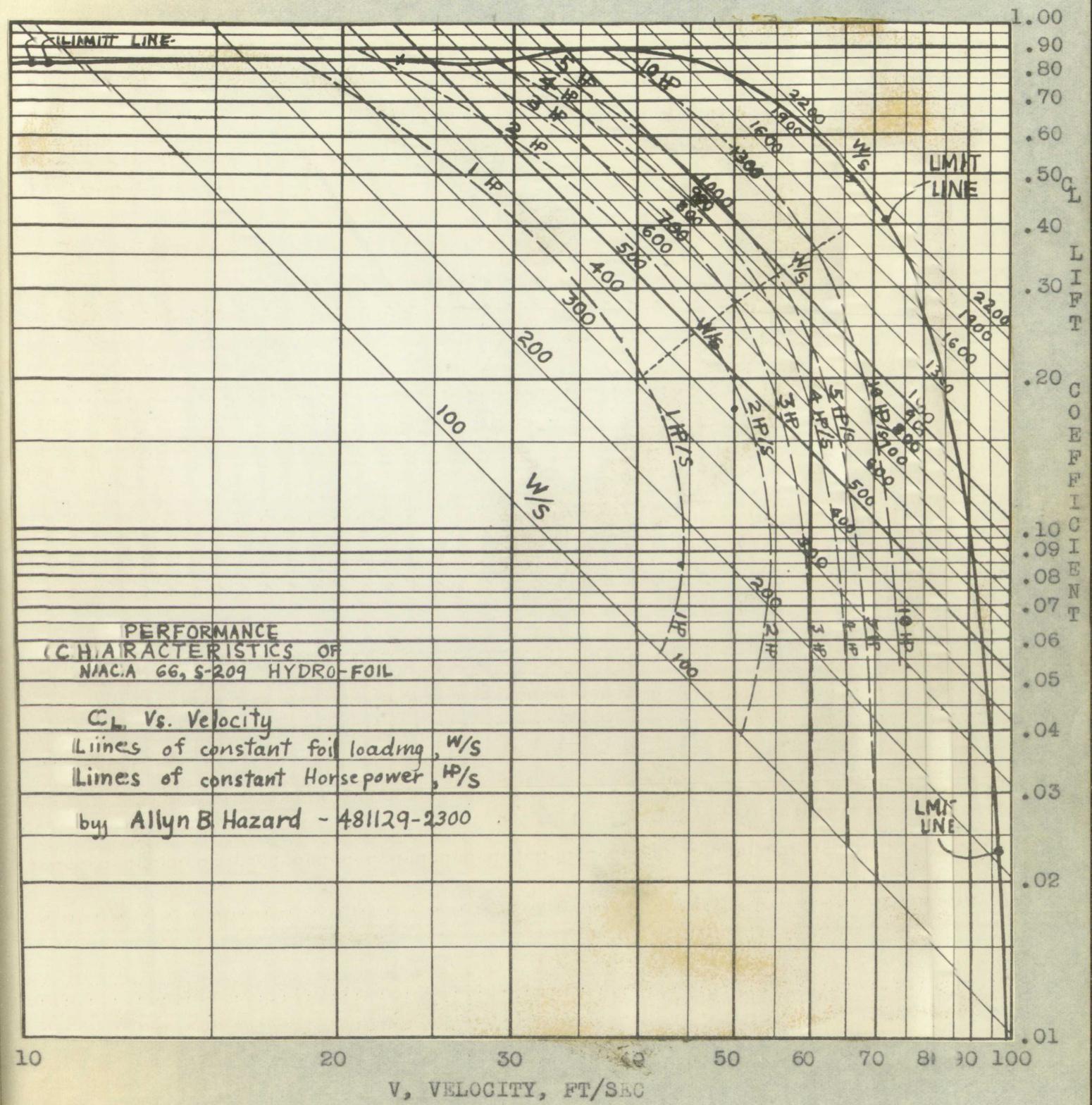
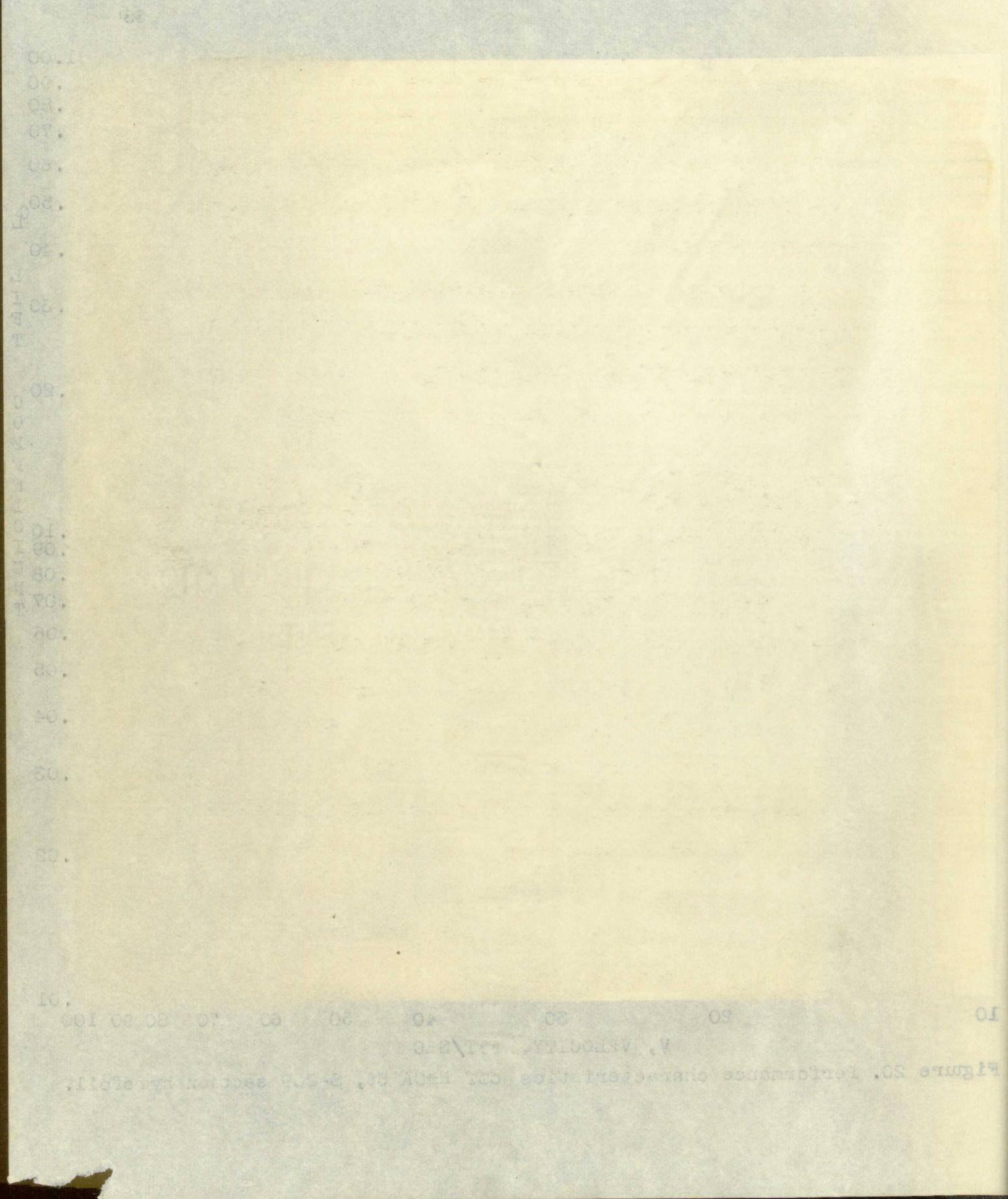


Figure 20. Performance characteristics of NACA 66, S-209 section hydrofoil.



in order to have a chart that would be valid for hydrofoils of any area. Of course it is necessary when calculating the total Lift or Horsepower to multiply the Lift and Horsepower data obtained from the chart by the total hydrofoil area, S.

Example. An example problem would help to illustrate the use of this figure and give some indication of the other information that is available from the chart. The specifications given are for WATER HAZARD II.

Gross Weight	W	650 LBS
Total hydrofoil area	S	1.5 SQ FT
Foil loading	W/S	433 LBS/SQ FT
Horsepower (75% Propeller Eff.)	HP	17.2 HP
HP/S		11.5 HP/S

The takeoff speed is determined by finding the location of the line W/S equals 433 and then following this in an upper left direction until the limit line is reached. This intersection is indicated by an X. From this intersection go vertically and read a value of the Velocity from the horizontal scale. The velocity found, approximately 3 feet per second in this case, is the takeoff velocity.

In regard to the Limit Line the region to the left of and below the Limit Line represents the most desirable conditions of operation for the NACA 66, S-209 hydrofoil section. When the angle of attack and C_L become large

and the following sentence from Drano's report on the shooting of
Lester H. Ritter, which was published in the Los Angeles Times, reads:
"The police officer who shot Lester Ritter was acting in self defense
when he fired his gun at the man, according to the coroner's
report." This is the same kind of language that was used by the
police in their reports.

The following statement from Drano's report on the shooting of Hughes
is also similar:
"The police officer who shot Hughes was acting in self defense when he
fired his gun at the man, according to the coroner's report."
It should be noted that the coroner's report does not mention the name of the
officer who shot Hughes.

Officer	Date	Time	Location	Reason
Officer A	1968-01-01	10:00 AM	123 Main Street	Shooting of Suspect X
Officer B	1968-01-01	10:00 AM	123 Main Street	Shooting of Suspect Y
Officer C	1968-01-01	10:00 AM	123 Main Street	Shooting of Suspect Z
Officer D	1968-01-01	10:00 AM	123 Main Street	Shooting of Suspect W

The following statement from Drano's report on the shooting of Hughes is also similar:
"The police officer who shot Hughes was acting in self defense when he
fired his gun at the man, according to the coroner's report."
It should be noted that the coroner's report does not mention the name of the
officer who shot Hughes.

enough or when the necessary high velocity is reached the hydrofoils will be operating in the region above or to the right of the Limit Line and cavitation will occur. The Limit Line then, represents the maximum values of the Lift Coefficient or Velocity that are practical of attainment without the expenditure of abnormal amounts of power.

Since cavitation is an important limiting factor in the performance of a hydrofoil boat it might be well to discuss cavitation further. It is well known that the pressure on an upper surface of an airfoil or wing section is negative with respect to the free-stream conditions in the fluid. The faster the wing travels through the water the greater is this negative pressure or the less is the absolute pressure. Now if the Lift Coefficient or Velocity of a hydrofoil becomes sufficiently great a point will be reached where the absolute pressure becomes less than the vapor pressure of the water and bubbles of water vapor and dissolved air will be formed. This condition is known as cavitation and it causes the undesirable conditions of increased drag and reduced lift. When the hydrofoils are operating in a region near where cavitation first occurs these bubbles will alternately form and collapse. So violently do these bubbles collapse that the upper surfaces will shortly present a

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pocked appearance as the metal is worn away. Cavitation is less likely to occur upon hydrofoils operating deep in the water since the absolute pressure increases with depth.

Maximum speed. Unfortunately Figure 19 does not give any information as to how much horsepower will be required to overcome air resistance and strut drag, and this information is necessary before the maximum velocity can be determined. Strut drag and wind resistance could be determined from tests of scale models, but since the results of such tests are not available it is necessary to make assumptions. The struts built for WATER HAZARD II were thick and rough in comparison to the hydrofoils. It is probably not too far wrong to estimate that the hydrofoils required one sixth of the power available, that the struts required one third, and that the air resistance of the hull would absorb the balance. The value of HP/S to enter on the graph would be the share of available HP required by the hydrofoils, or one sixth of 11.5 HP_{avail}/S, 1.9 HP/S. The intersection of HP/S = 1.9 with W/S = 433 is indicated by a dot. The velocity corresponding to this dot is 50 ft/sec or 34 MPH which represents a pretty good, although probably high guess of the maximum velocity.

It is not possible to make accurate predictions of

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the performance of a hydrofoil boat without benefit of tank tests on the struts and wind tunnel tests on the hull. It was not considered practical to make any attempt to predict the maneuverability of this type of boat, for there are too many variables to be considered, all of which must be given an assumed value. Besides, one of the functions of this project was to determine the extent of the maneuverability of this type of hydrofoil boat by actual tests on the prototype.

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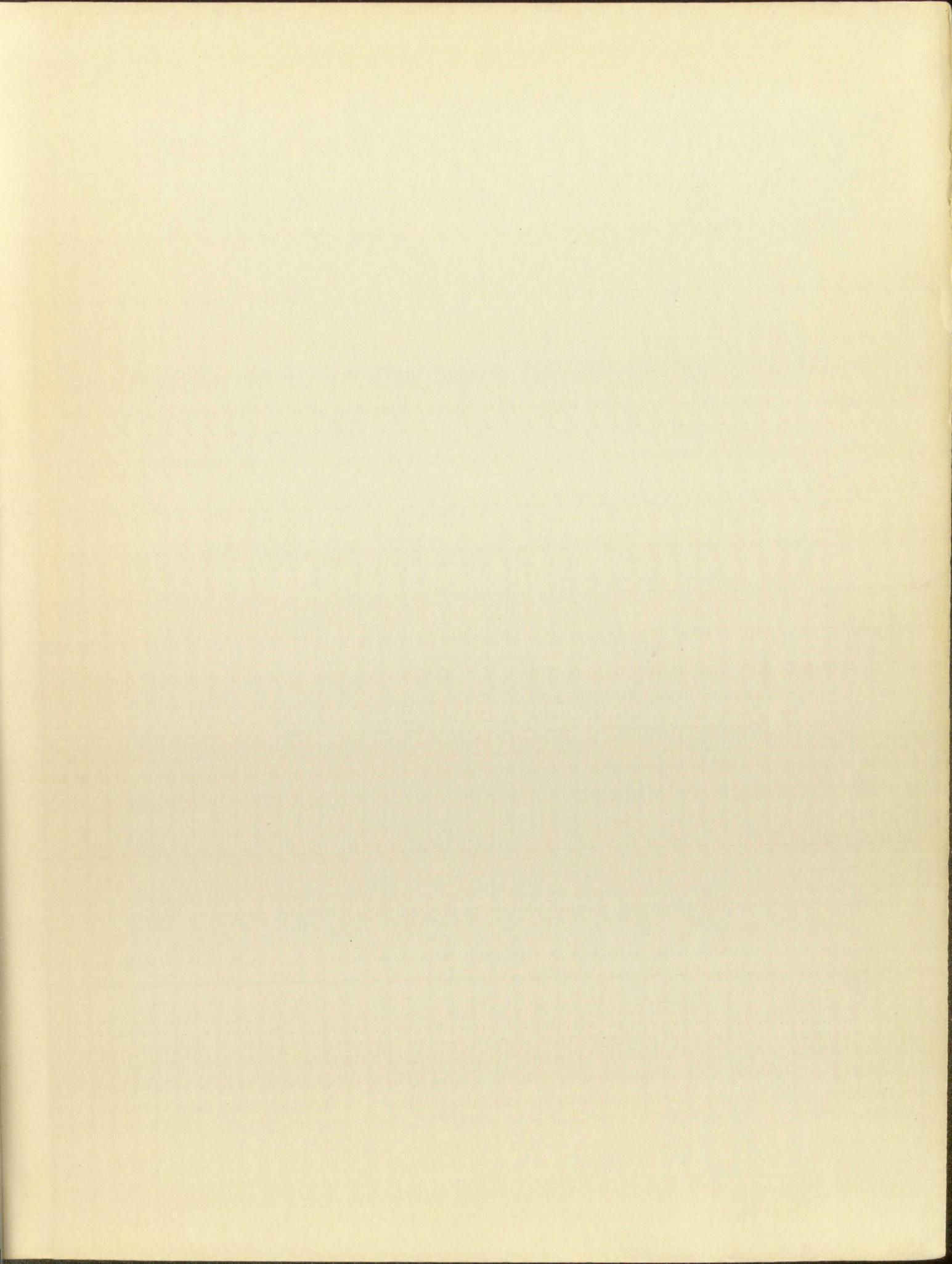
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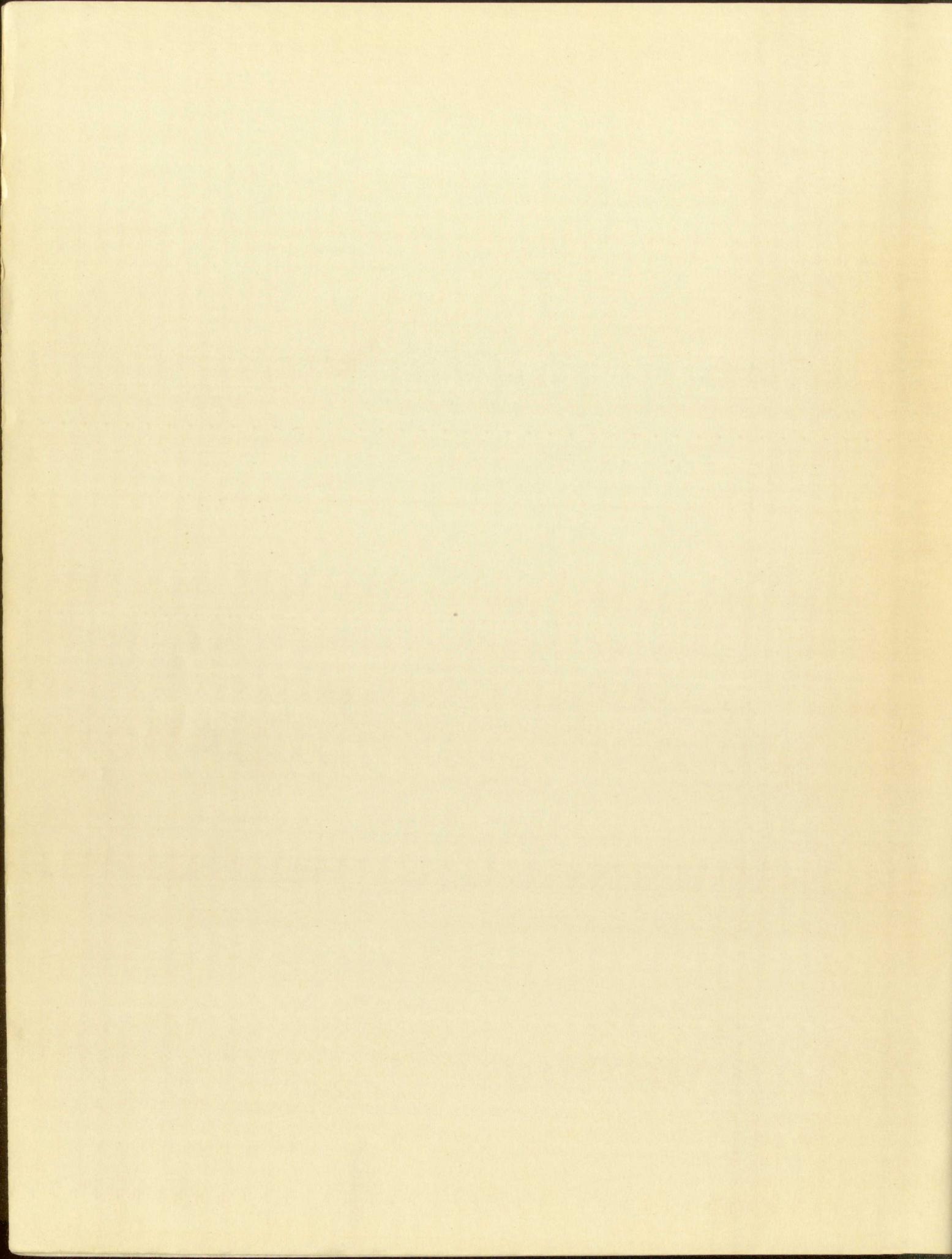


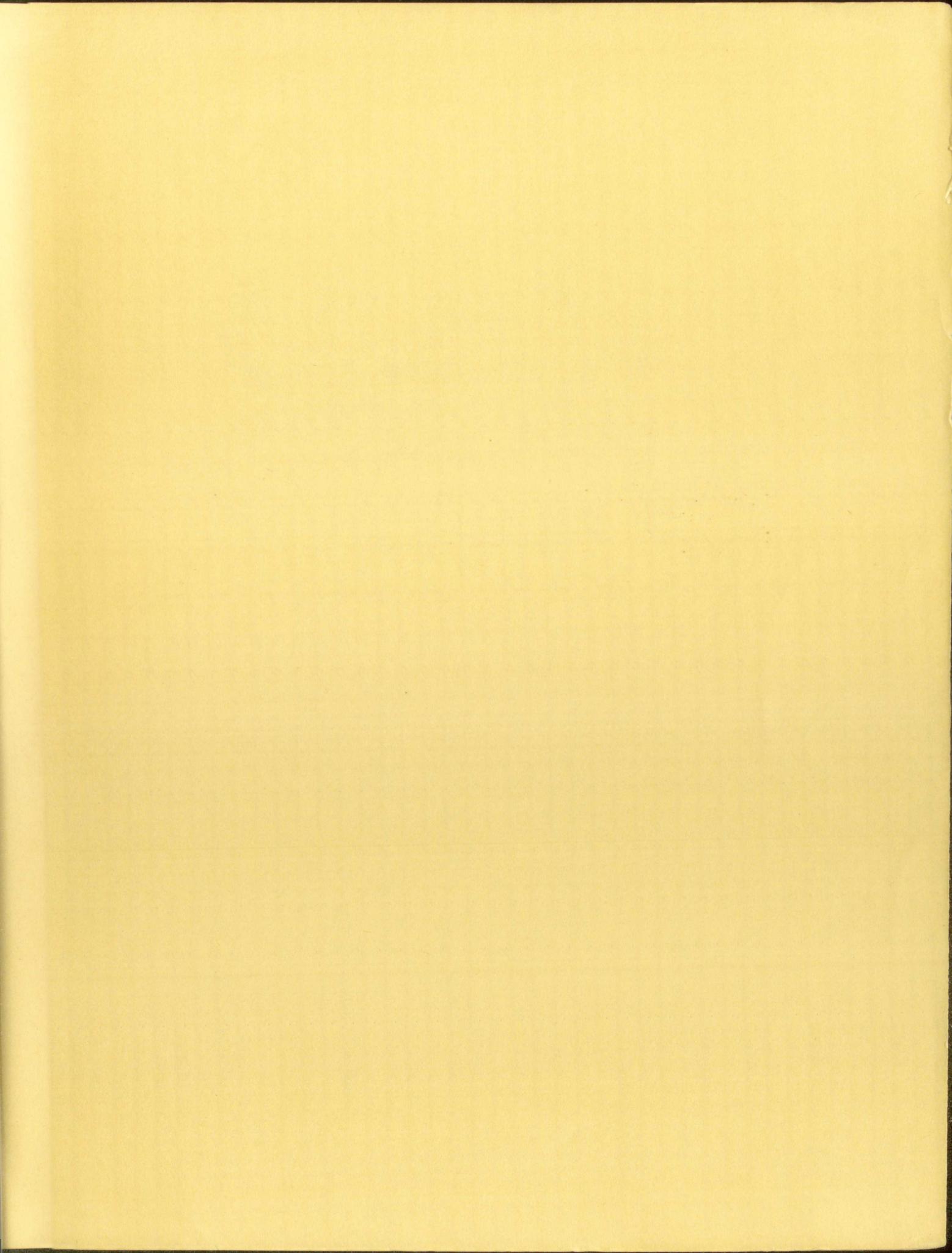
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