

VIRGINIA'S MARINE LABORATORY

Present and Future

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## FOREWORD

There is evidence of greatly increased interest in marine science. With this, the demand for information concerning organizations working in oceanography also grows. The following report is designed to fulfill part of that demand by describing, in some detail, the organization and operation of Virginia's marine research group, the Virginia Fisheries Laboratory.

In this report the reader will find data concerning the external and internal organization of the Laboratory, its finances and legal authorization, its personnel and projects, and an appraisal of its future. Estimates of additions and improvements needed to permit full realization of its tremendous potential are also included. The main body of the text comprises only a brief consideration of the general aspects of each phase of the operation. Greater detail, including tabular and graphical supporting information is included in the appendices.

## INTRODUCTION

The Virginia Fisheries Laboratory, in spite of its rather inappropriate name, has made investigations in many fields of marine research since it was founded in 1940. Its functions, explicitly stated by the Virginia General Assembly (Section 28.250.1 of the Code of Virginia) are in part: "The Virginia Fisheries Laboratory is authorized and directed to conduct an hydrographic and biological study of the Chesapeake Bay and the tributaries thereof and all the tidal waters of the Commonwealth....In conducting such study the Laboratory is authorized to accept and make use of such funds as

are made available from any source, public and private, for the purpose of furthering the study..."

The General Assembly at first placed the Laboratory directly under the College of William and Mary and the Commission of Fisheries. The alliance with both organizations is still very close but since 1944 the Laboratory has had the legal status of a separate state agency receiving appropriations from the General Fund.

The primary research effort has been in marine biology, but members of the staff are also working actively in physical, chemical and geological oceanography. In addition, an annual grant for physical and chemical research has been made to the Chesapeake Bay Institute of The Johns Hopkins University for over 12 years. Particular areas of investigation will be discussed below and current projects are listed in Appendix VIII.

In addition to their research projects, staff members are engaged in teaching. For several years the College of William and Mary has awarded Masters degrees to students who received most of their advanced training at the Laboratory. Ties were further strengthened in 1960 when the College formally organized the Department of Marine Science operated jointly with the Laboratory.

The Laboratory has attained a high rank among institutions devoted to biological oceanography. In size it already ranks about third among marine biology units along the Atlantic Coast. Plans have been made for a permanent staff (including part-time workers) of 68 to 70 and for an annual budget of about \$400,000 by June 1962.

Further expansion of research staff and budget has been recommended by the Board of Administration for the next three biennia.

#### GEOGRAPHICAL LOCATION

The Laboratory is very advantageously situated on the York River, a major tributary of the Chesapeake Bay estuarine system (see Figures 1 and 2, Appendix II). This strategic location on lower Chesapeake Bay is near the lower end of the marine biogeographical realm which stretches from Cape Hatteras to Cape Cod. Thus, access is afforded to communities and water masses from the Cape Cod-Cape Hatteras and the Cape Hatteras-Cape Canaveral realms. In addition to the large endemic flora and fauna, organisms from more northern and more southern regions are common. (Check-lists are included as Appendix XII). Though the chemically and biologically rich Continental Shelf is fairly wide off Virginia, the Gulf Stream is close enough to make visits there practicable for the small RV PATHFINDER. The Laboratory is also in the center of a great circle extending from Labrador on the north and the Windward Islands on the south, and encompassing most of the western north Atlantic, and in this regard is probably the most strategically located of all the major, full-time marine centers.

The main laboratory is only 35 miles below the fresh-water line of the York and 33 miles from the sea. Thus, a wide variety of aquatic environments is readily available to the staff and students. A permanent branch station has recently been established at Wachapreague on the Eastern Shore of Virginia. This base affords

access to the true salt marshes, back embayments, barrier beaches and open waters of the Atlantic coast.

Access to unspoiled marine habitats is only one advantage attained by the location of the Laboratory. It is also situated in close proximity to one of the busiest maritime centers in the world, the Newport News-Hampton Roads-Norfolk area. The goods and services of such a center are a useful asset. More importantly, such an area presents many problems in marine biology and physical oceanography whose solutions will become more urgent with increasing use of nuclear-powered vessels and shore-based atomic activities. Additional problems are being raised by advancing industrialization and population levels. With its 60 foot channel the lower York is a deep-water port, offering access and shelter to ocean-going military and merchant vessels. A steady traffic of heavy cruisers, tankers, and merchant-men passes by our Laboratory buildings.

Some marine stations are located many miles from other academic institutions. The Laboratory with its Department of Marine Science is only 13 miles from the main College campus at Williamsburg and 30 miles from the Norfolk branch of the College. In nearby Richmond are the excellent laboratories and libraries of the University of Richmond, the Medical College of Virginia, and the Richmond Professional Institute. The many libraries and other facilities of Washington, D. C. are only 140 miles away.

The Laboratory is also well placed to be of service to other educational institutions. In addition to public and private schools, there are over 50 colleges and universities within a 300-mile radius. Many high school and college students come to the Laboratory for field trips and for courses and research experience in the summer. Such visits are encouraged, since every science student, certainly every biology major, should acquire some familiarity with the sea where life began. Several academic groups and governmental agencies have used Gloucester Point as a place to serve their scientists who wished to use locally available marine plants and animals in research. It is hoped that this joint use will increase.

## FACILITIES

### Buildings

For the first few years of its existence the Laboratory's small staff was housed on the campus at William and Mary, later in a temporary building at Yorktown. The first permanent building was constructed across from Yorktown at Gloucester Point in 1950.

The main permanent facilities at Gloucester Point now consist of four brick and concrete laboratory buildings. The grounds contain about three acres and additional real estate is being acquired. A branch laboratory at Wachapreague is operating in rented quarters at present. A permanent brick and cinder block building is in the first stages of construction. It will contain a large salt-water

laboratory, several office-laboratories, three dormitory rooms and a galley.

All buildings are described in detail in Appendix III. The main laboratory (6,400 sq. ft.) constructed in 1950, contains the administrative offices, an exhibit-lecture room, one large and two small salt-water laboratories, a cold room with running salt water, a chemistry laboratory, several offices for scientists and an extensive and rapidly growing marine library. The annex building (7,618 sq. ft. gross), built in 1958, houses the galley, dining room-lounge, several dormitory rooms, main class room, laboratories for radiobiology, planktonology, carcinology and ichthyology, the ichthyology collection room, graduate laboratory and office, dark room, photographic preparation room, illustration laboratory, and several offices for scientists. The small former maintenance shop (enlarged to 2,000 ft. gross) is being converted into a salt water laboratory with storage and office facilities on the second floor. A building of frame and metal-siding recently acquired houses the maintenance staff and facilities and serves as a storage area for the research groups.

A new laboratory to house the Microbiology-Pathology Research Department is under construction to be available, if plans materialize, in June 1961. Both the first floor and basement will be used for research. The reinforced-concrete roof, which like the other floors will be served by fresh and salt water, gas and air, will be used for outdoor culture work.

Needed and projected, to be financed by state and federal funds, are a greenhouse-type building housing large salt water tables and tanks, larger outdoor tanks and ponds, and especially, a large controlled-conditions laboratory for precise physiological experiments. Concerning the latter, the staff and administration are acutely aware that biological oceanography has been operated at too gross a level. Detailed and precise experiments on marine organisms under conditions of precise control are needed. Control of such variables as salinity, light, temperature, oxygen, tidal effects, trace elements and other chemical factors, and contaminants will require a well-engineered laboratory building with a much more satisfactory salt-water system than is now available.

Because of the increase in students and summer residents, there is need for more adequate housing near the Laboratory grounds. In the area, competition for summer housing is keen and seasonal prices are high.

#### Other Equipment

A list of special laboratory equipment now available is supplied in Appendix IV. The radiobiology laboratory, which has been established under two contracts with the AEC, houses the counters and other equipment usual to that type of facility. Four trucks and three station wagons comprise the rolling stock.

The research fleet (see Appendix V) consists of the specially built 55-foot research vessel PATHFINDER; a 27-foot inboard research

launch, the OBSERVER; and seven skiffs of varying lengths powered by outboard motors. Thus, various types of vessels are available for visiting stations along the Tidewater rivers as well as the Bay and collection points over the Continental Shelf. The Laboratory maintains a landing in a sheltered cove nearby where the large vessel is regularly moored and to which all small boats are taken when storms threaten.

Though the PATHFINDER is small and consequently often uncomfortable, she will safely carry her complement of scientists to their stations. She was designed for her job and is not, as is the usual thing, a conversion. However, her limited range and capacity and her inadequate sea-keeping qualities necessitate making plans for a larger vessel in the very near future.

#### ADMINISTRATION AND FINANCING

A Board of Administration is responsible for the operation of the Laboratory. The President of the College of William and Mary and the Commissioner of Fisheries serve as co-chairmen, thus maintaining the official connection between the Laboratory and their respective institutions. Other members of the Board are the Director of the Laboratory and three citizens appointed by the Governor. At present the three appointed members are: Dr. R. W. Ramsey, Head of the Department of Physiology and Pharmacology of the Medical College of Virginia and <sup>Member of the Corporation</sup> ~~Trustee~~ of the Marine Biological Laboratory at Woods Hole; Mr. James E. Mays, a journalist; and Mr. R. L. Miles, Jr., an oyster planter. These members were appointed in 1960 and

are likely to serve until 1968. The relationship of the Board to the Laboratory and to the Governor is illustrated in Appendix VI.

Budget requests authorized by the Board of Administration are presented directly to the General Assembly by the administration of the Laboratory. As a separate agency, the Laboratory has fared reasonably well in funding and growth (see Appendix VII). Annual support for maintenance and operations during the 1961-1962 biennium will be over \$415,000, including long-term grants. Of this over \$350,000 will come directly from the General Fund of Virginia.

In 1956-60, less than 15 per cent (\$31,426) of the total budget was derived from grants, excluding the \$29,580 received for a short-term summer training institute. Thus, there is ample room for safe expansion into the grant research area.

Despite the increasing availability of grant funds from outside sources, chiefly Federal, the Laboratory has maintained the policy of financing all major scientific personnel and their primary research out of state-supported funds. This policy permits the major scientists to operate at peak efficiency and capability, while assured of some continuity of personal financing. Within this framework, outside grants will be extremely useful in permitting a broadening of research capabilities in areas of mutual interest to both the Laboratory and the granting agency. Should grant support be organized so that it is less variable and more reliable, this policy will probably be altered.

## PERSONNEL

The permanent staff (list appended) now totals 65 including a few part-time workers. Five new positions are to be added after 1 July 1961. The authorized strength for the biennium 1960-62 has been established at 68 to 70. When the new positions are filled 28 trained scientists will be serving in professional capacities and there will be 14 technicians and aides. Nine of the 28 will be at the doctoral level, seven at the magisterial and the rest will be baccalaureates. The librarian, assistant administrative director and information officer are also trained biologists.

The Laboratory also employs eight graduate assistants year round and ten or more student assistants in the summer. The annual budget is designed to permit employment of four to six summer researchers or teachers at the Ph.D. level.

Expansion of the staff is planned for the next two biennia. It is hoped that activity can be expanded in the Research Sections now active as well as in physiology, biostatistics, taxonomy, and physical, chemical and geological oceanography.

## INTERNAL ORGANIZATION

Internally the Laboratory is organized into three major groups, the Research Group, the Academic Group (the Department of Marine Science of the College of William and Mary), and the Administrative Group (see Appendix VI). The Research Group is subdivided into major Research Departments and Special Projects Units. The Research Departments are: Basic Ecology-Pollution, Carcinology,

Ichthyology, Malacology, Microbiology-Pathology, Oceanography (physical, chemical, and geological--the efforts in the latter are small at this time), Planktology, and Physiology. The Special Projects are: Research in Molluscan Physiology, Oyster Drill Research, Research in Parasitology, and Embryology Research. These, with few changes and additions (e.g. Biostatistics) will be the areas of special interest to the Laboratory in the foreseeable future. The precise organization of the Laboratory is presented in Appendix VI.

Much of the business of the Laboratory is conducted by committees, especially in preliminary planning. The Department Heads, plus the Director constitute the Senior Staff. This group assists the Director to determine courses of policy. The Scientific Committee, made up of department heads and committee heads, co-ordinates activities which are mutually interdependent, e.g. vessel operations, central data storage, library, editorial routines, academic activities.

Once the major areas of research are laid out by the Senior Staff and approved by the Director (who, of course, is responsible to the Board of Administration) the scientists in charge of the individual projects are given a relatively free rein. Though there are specific areas, the so-called "official" scientific areas, which are of major interest to the Laboratory and to which most of the scientific effort is put, each scientist so desiring is encouraged to spend a certain amount of time in research in his own particular field of interest and he is given physical and temporal assistance to do so.

The Academic Group of the Laboratory makes up most of the staff of the Department of Marine Science of the College of William and Mary. They are responsible for teaching in the Department and for planning its courses of study. This connection is a historical and legal one, soundly based on Section 28-248 of the Code of Virginia which established the Laboratory under the "control and supervision of the College of William and Mary...."

In administration, the Director is assisted by an administrative assistant, the Assistant Administrative Director, to whom maintenance personnel and the secretarial staff are responsible. The work of the Research Group, faculty, and the librarian fall directly under the supervision of the Director. An Assistant Research Director aids in the supervision of the research group and serves as Acting Director when necessary.

#### RESEARCH PROGRAM

A list of the present and pending research projects is included as Appendix VIII. It will be noted that both basic and applied research problems are represented.

In many projects affinities are difficult to fix. For example, the excellent and active programs in oyster (Malacology Research Department) and crab (Carcinology) biology have produced results directly beneficial to the seafood industry and added much general knowledge on the biology of invertebrates of the area. The Ichthyology Research Department is deeply concerned with the life histories and the biology of fishes of the estuaries and the ocean.

Knowledge gained is of use to ichthyology as well as to the commercial fisheries. The current study of the ichthyoplankton and hydrography of the Continental Shelf is a significant effort and has produced results interesting academically and practically.

One program of wider interest is the significant research on the helminth parasites of fishes. With strong grant support in this area, scientists from the Laboratory have ranged the coast from Massachusetts to Florida and the Atlantic to Bermuda and the Windward Islands. The Laboratory has also participated in the Antarctic Research Program of the National Science Foundation for three years. Further grant-supported effort in this remote area is anticipated. Collections of external and internal parasites are to be made from Australia, Singapore, Zanzibar, Capetown and Dakar, thus filling in large gaps in our present knowledge of the distribution of the parasites of poikilothermic vertebrates.

In addition to those areas which are usually the province of a marine laboratory, some hitherto neglected ones are now or will soon be emphasized. A department of Microbiology-Pathology has recently been established. Three scientists, two technicians and an aide are already employed and a three-fold expansion in the program is planned for the next five years. A building is now under construction to house this unit. Its program will be concerned with both free-living and parasitic micro-organisms. Efforts will also be directed toward developing appropriate culture techniques for cells, tissues and germ-free organisms.

The Laboratory has recognized the need to gather basic observational and experimental information concerning the interactions between normal physical parameters and biological entities. It is also extremely interested in studies of the role of various industrial, domestic and agricultural pollutants in the marine habitat and the communities therein. To facilitate studies in these important areas the Basic Ecology-Pollution Research Department was established in 1959. It consists of three scientists and two aides. Investigations on the productivity of periphyton, on the detailed ecology of benthic and attached animal communities, and on the normal chemistry of the water are being actively pursued. Also involved are biological and hydrographical studies of the sites proposed for various atomic activities as well as those which will receive industrial and domestic wastes.

If present plans can be effected, activity will be increased in physiological research, biostatistics, taxonomy, and physical, chemical and geological oceanography.

Concerning physiological research, it has been apparent to all for some time that biological oceanography has been conducted as primarily a field science. It has only recently become generally recognized that detailed and definitive laboratory observations and experiments are a necessary complement to field work in order to achieve meaningful results. Development of a well-rounded program demands greater effort in physiology.

Increased emphasis on biostatistics and other mathematical techniques both in the physical as well as in the biological programs is needed. Accordingly, our mathematical unit will be augmented.

Taxonomy is a vital field which has been very much neglected in the expansion of marine research activities, as well as in all of biology. A group of well-trained taxonomists working in the various important groups of marine animals and plants is badly needed, not only by our laboratory but by marine biology in general. Thus, this addition to personnel will permit us to serve marine science as a center of needed research and training activities.

An increase in personnel in physically oriented marine sciences is also vitally needed. The interaction between the biological and physical aspects of the marine environment is generally recognized. It is, therefore, important that any well-rounded oceanographic program, even one which is primarily biologically oriented, be supported by a sound physical oceanography group .

Negotiations have been started with the U. S. Coast Guard and the Chesapeake Bay Bridge Tunnel Commission to establish permanent oceanographic stations on appropriate lighthouse platforms along the Chesapeake Bridge Tunnel and on the Texas Tower that is to replace the Chesapeake lightship. It is planned that these permanent stations will house equipment that will make continuous and/or periodic records of various physical features of the water. If this project can be arranged, the Laboratory will have to supply automatic sensing and recording equipment and data storage and computer facilities.

Increased studies of the chemistry, ecology and geology of natural and man-made sedimentary deposits are planned.

In establishing and carrying out this research program the recommendations of the National Research Council's Committee on Oceanography (as reported in the series "Oceanography 1960 to 1970") have been followed except in those areas where certain local conditions dictate otherwise or where a basic difference in philosophy exists as to relative need for biological effort.

As to the last point it is reasoned that society needs as detailed and accurate knowledge of biological phenomena as has been attained for the physical sciences. But biologists have not achieved this level of understanding. A good part of this difficulty arises because biological entities, e.g. cells, tissues, organisms and communities, lend themselves to precise analyses much less readily than do the more easily manipulated physical and chemical processes. In addition, in the biological realm details of physics and chemistry as well as those of biology must be considered. In order to achieve the needed level of precision in understanding, probably three times the effort will be necessary in biological research as must be put forth in physical science. This increased endeavor should include personnel, equipment, and major research facilities. Unfortunately, in most research programs well over half of the total effort is being expended in the physical areas.

If we are to achieve the level of understanding needed, the current practices will have to be changed and much more effort

expended in marine biology in order that a well-rounded and complete research effort can be mounted in oceanography. Fortunately, of all the scientific disciplines involved in marine research, biology is probably the most rapidly expandable. It seems apparent that such expansion must be quickly undertaken because many, perhaps most, of the answers we must get are ultimately biological.

#### ACADEMIC AND TRAINING PROGRAM

Early impetus for establishing this marine laboratory came from knowledgeable personnel of the College of William and Mary. As a result, the Laboratory has always been associated with the College in teaching. Until 1959 the academic side of the program was offered in conjunction with the Department of Biology and the degree was the Master of Arts in Aquatic Biology. In the summer of 1959 the teaching portion of the Laboratory effort was separated from the Department of Biology and established as the Department of Marine Science. The degree offered is the Master of Arts in Marine Science. Though the program is primarily for graduate students, courses are open to advanced undergraduates.

Fourteen members of the present Laboratory serve also as faculty members for the Department of Marine Science (Appendix IX). Of these, nine hold the Ph.D. degree. Provision has been made to add three other members to the research and teaching staff, which will bring the faculty to a total of 17 with 11 Ph.D.'s. Further increase is anticipated within the next three biennia. Associate

members from other departments of the College, Dr. Alfred R. Armstrong of Chemistry and Dr. M. A. Byrd of Biology, provide liaison with their departments and advice in their specialties.

At the present time the curriculum leading to the Master of Arts in Marine Science comprises 15 formal courses, plus a methods course, two problems courses, one seminar course, and a thesis course (for annotated list, see Appendix X). Though there is no doctoral offering as yet, the faculty and the Board of Administration of the Laboratory have approved and authorized one. The Board of Visitors of the Colleges of William and Mary has also strongly endorsed this program.

As in most marine institutions, activities are accelerated in the summer. From four to six Ph.D.'s are added to the research and teaching staff. In addition to regular academic courses offered, the Laboratory has recently been associated with the National Science Foundation in two summer programs. Each year ten students are brought to the Laboratory in the Undergraduate Research Participation Program and from 7 to 13 teachers in the Teacher Research Participation Program. In both groups the enrollees actively participate in research projects. An additional ten students are supported by the V.F.L. Summer Aide Program which is designed to acquaint students with marine activities and to encourage interest in marine work.

A service offered to public schools throughout the year is the V.F.L. lectures. Each year over 5,000 primary and secondary pupils visit the Laboratory for lectures, motion pictures and demonstrations in marine biology and conservation.

A list of graduate students who have been in the program during the last 14 years is appended (Appendix XI). As can be seen of the 14 who have graduated, six have gone on to further graduate work and eight are actively engaged in marine work. It is interesting that of the 27 who have been admitted to the program 11, or 40 per cent, were added in the 1960-61 academic year. Recruitment in earlier years was not especially active. However, this has been changed and it is anticipated that enrollment will be increased further.

Because the entire organization is marine-oriented and all of the faculty is heavily engaged in research our graduate students have a better than usual opportunity to become intimately familiar with the field. This advantage is increased by the fact that the student's entire program is carried out on the seacoast. Little time is lost in traveling from an inland campus to the sea and the sea, itself, is a constant classroom companion.

Excellent though the marine training program is, the lack of adequate sea time is evident. PATHFINDER is too small to take more than a few students on short trips. A larger, more seaworthy research vessel is badly needed.

The Laboratory regularly maintains six graduate research assistantships out of its own maintenance and operations funds. Several more are supported from research grants. However, this is not enough. A larger number of assistantships is needed. More essential are from 10 to 15 substantial fellowships. With these additional candidates could be recruited and the students could finish their work in one and a half to two years instead of the usual three required under present conditions.

#### DISCUSSION

The foregoing material amply describes the organization and operation of Virginia's marine laboratory. However, a brief reconsideration of several particular segments may be advantageous.

The essential raison d'etre of this organization is to participate in the accumulation of knowledge and understanding of the biological and physical processes of the sea. A portion of the program is also dedicated to making the results of this effort available to the various sectors of the maritime economy that are interested in the details of the sea.

It can be seen from the above material and by comparison of the various aspects of staffing, organization, and financing that Virginia's marine laboratory is well forward in the ranks of the important marine stations in the United States. This is remarkable considering that its major support has been the state General Fund. As has been mentioned, the status of the Laboratory as a separate

state agency and its administrative and academic organization have contributed significantly to this sound position.

If numbers of personnel are any criterion, this Laboratory certainly ranks among the first three or four, in biological oceanography, on the Atlantic Coast and not much further down the list on a national basis. And a significant program of continued expansion has been authorized by the Board of Administration. It is now up to the Director and staff to implement it. Though it is expected that a significant portion of the support for major personnel and their essential research activities will continue to come from the General Fund, a great deal of assistance must be secured from private philanthropy and federal agencies. The support of all of these agencies will be well-justified. The potential for significant scientific and academic accomplishment at Virginia's marine institute is great.

Specifically its attributes are:

- 1) It has a major staff in biological oceanography with rapidly developing support in other marine disciplines. The Laboratory has also, through a regular unrestricted grant, made use of the facilities and staff of the Chesapeake Bay Institute of The Johns Hopkins University for over 12 years.

- 2) The entire organization is devoted entirely to promotion of marine activities. There is no watering down, equivocation or submergence of the marine work to any other over-riding program.

- 3) The major part of the effort is a year-round, on-the-premises, permanent operation. The research, academic, and administrative groups are in residence and available twelve months of the year, not just four.

4) From the logistical as well as biological and hydro-graphic points of view, the location of the Laboratory is extremely favorable. Equal access to Newfoundland on the north, the Windwards on the south and most of the western north Atlantic is afforded by its strategic location. The lower end of Chesapeake Bay, including the lower York, is considered as an excellent deep-water harbor.

5) The proximity of the marine station to its academic affiliate, the College of William and Mary, is also favorable. An easy half-hour drive brings College students to the Laboratory for field trips and other seaside activities and takes the Laboratory staff to the main campus.

6) All of the agencies and institutions and cultural activities of Richmond, Washington, Baltimore area are within easy driving distance. In fact, the Gloucester Point facility is no further from Washington and Baltimore than the marine stations of many schools are from their own campuses, and communications are much better. Airlines, train and bus terminals are nearby and all-weather, high-speed highways pass within sight of the Laboratory grounds.

7) Virginia as a great maritime state has a high stake in marine research and will undoubtedly continue to offer strong support in this area of endeavour.

8) The faculty and curriculum of the Department of Marine Science is an excellent one. With its emphasis fixed primarily on marine science the department is in an excellent position to train

students in this field. The continuous physical and intellectual proximity of the students to the sea and her problems and to a research program of major proportions can be a significant factor in producing superior marine scientists and teachers.

9) The Board of Administration of the Laboratory is a well-rounded one with an intense interest in the problems of the sea and in research and academic pursuits. The improvement in staff and facilities which have been endorsed by them will do a great deal to promote further building of a sound program of marine research and training.

In assessing the areas which must be stressed, the staff and administration of the Laboratory have considered the following problems in detail.

Review of past efforts in biological oceanography has disclosed the obvious fact that it has been primarily a field effort, quite often of the crudest sort. In order to achieve the precision of understanding this crude approach must not continue dominant. An effective blending of detailed controlled field and laboratory experiments coupled with precision instrumentation and intelligently joined to survey-type work is absolutely necessary. To this end the Laboratory wishes to adapt and/or develop precision instruments for use in studies of the physiology, behavior, biochemistry of marine organisms and improved experimental field techniques are also needed. A physiology laboratory which will house the needed precision controlled-conditions laboratories and an improved biostatistical unit

with automatic data processing equipment are vital to this purpose. Instrument technicians and maintenance facilities must also be made available.

Microbiology of the sea has been much neglected. Greater study of both free-living and parasitic microbes is needed. The roles of viruses, bacteriophages, bacteria, protozoans and microscopic plants in the marine environment and the interactions between and within their populations, as well as their interactions with other segments of the communities in which they occur, must be understood. To do this, new field and laboratory techniques are being sought. However, before much can be done along certain important lines, specialists must be added and facilities for their work must be procured. The newer instruments, such as electron microscopes and accessories, automatic particle counters and discriminators, must be added. Recently perfected techniques such as electrophoresis, seriology, and tissue and cell culture, must be properly exploited.

Because of the obvious importance of understanding the physical aspects of the sea, both for themselves and for the bearing they have on biological populations, there has been an increase in emphasis of this phase of the work. Efforts in physical, chemical and geological oceanography are now underway and will continue to be stepped-up. Additional personnel and equipment are planned for this. A more adequate vessel for offshore work, automatic data recording and processing equipment is badly needed.

The Laboratory is in a particularly favorable position to move into work in these areas because of the proximity of all of the scientific and engineering and other technical personnel and the special equipment located at the National Aeronautics and Space Administration Langley facility, the Naval Weapons Station, Fort Eustis and Norfolk Navy Yard. Skilled help and advice are available from all of these sources. Specialists will be added to the Laboratory staff when needed.

In keeping with the necessity for improving and increasing the training of marine scientists as has been pointed out by the Oceanography Committee of National Academy of Sciences-National Research Council and Committee on Education and Recruitment of the American Society of Limnology and Oceanography, the Laboratory and Department of Marine Science are augmenting and improving the academic activities. The proposed facility, faculty and equipment additions which have been approved by the Board of Administration will do much to aid in this direction. More support from philanthropy and federal agencies is needed. Efforts could be immeasurably improved by additional research and teaching assistantships and especially by adequate fellowships for graduate students.

The excellent support from federal agencies, particularly the National Science Foundation, of the summer research participation programs should be continued and additional funds should be made available to aid undergraduate and graduate students from other schools to take advantage of our seaside facilities and teaching

staff. An unlimited academic support grant would be particularly useful in this regard.

Both the NAS-NRC and ASLO committees have recommended that students be given a great deal more training at sea. The staff of this Laboratory has been acutely aware that the most serious shortcoming of the present academic program is the lack of seagoing facilities which are adequate to give the students all the sea-time they should have. To remedy this fault an improved vessel with greater personnel capacity and range must be obtained.

It is important that in the rush to secure data in applied areas of marine sciences, always the easiest to finance and develop, the basic research not be neglected. The staff and administration of the Laboratory are making every effort to see that this is not done. As has been mentioned above, scientific personnel are allowed time and equipment to do work of their choice. This aspect could be very much improved if additional federal research grants could be used to provide field and laboratory assistants. Thus, a greater portion of the highly-trained professional's time could be spent in planning and interpreting results of all types of research and in working in advanced areas.

Additional effort in basic research particularly in currently unpopular or underdeveloped but much-needed areas, e.g. taxonomy of invertebrates, plankton and bacteria, should be made. For some time the possibility and necessity of adding scientists whose chief effort would be in these areas has been considered. Support of year-round

scientific positions such as endowed research chairs, by private philanthropy and/or grants from federal agencies would be useful for this purpose.

In establishing a specialized facility like a marine laboratory certain items of basic equipment and material are necessary. Once these basic facilities, e.g. the marine library, vessel, special oceanographic equipment, are available, additional use can be made of them with very little extra effort and expense. For instance, equipment can be used for both research and training, as it is now, or several institutions can share the vessel and library facilities, as is done at Woods Hole.

To permit even more efficient use of its facilities, the administration of the Laboratory has, for some time, been interested in encouraging other groups such as related federal research agencies to locate nearby and thus make use of and complement our existing facilities. Properly oriented neighboring institutions could do much to augment the program. More directly, the Board of Administration has approved the establishment of a privately endowed foundation to make additional facilities available for summer students, teachers and researchers from nearby institutions. These people will be invited to make use of the facilities in any research activities requiring the Laboratory's present facilities or in special facilities which the foundation could provide. Needed for this are additional laboratory space, housing for scientists and their families and housing for single summer students and married graduate students. Federal and private funds must be sought.

In conjunction with this a summer facility grant or special summer fellowships could be made available by private philanthropy and/or some appropriate federal agency. Thus, skilled and interested investigators, teachers and students could make good use of the Laboratory's excellent location and other attributes. The obvious advantages of the Laboratory, itself, plus its proximity to the numerous academic and research institutions which are within a 250-mile radius of Gloucester Point make it almost certain that such a summer research program will contribute materially to the advancement of marine science.

There seems little reason why institutional scientists from the Richmond and Washington areas should trek to more distant places when the same or equivalent experimental organisms and facilities could be had at Gloucester Point. This proximity to institutions of advanced scientific activities, plus the excellent biogeographical characteristics, plus the long season (our waters, in contrast to those elsewhere are open all year round) makes Virginia's marine laboratory particularly attractive in this regard. The proximity to, yet isolation from nearby populous industrial and shipbuilding areas makes the Laboratory even more attractive for further development of all phases of its activities.

SUMMARY  
of  
Needs for the Future

Virginia's marine laboratory, its buildings, research facilities, financing and organization have been described in detail. It has been shown that the Laboratory, as it is now constituted, is a major marine research center with capabilities in many areas, including some which have not received much attention elsewhere despite their obvious importance. The staff and administration are confident that objective study of this organization will reveal that it is a potent force for progress in marine science. On the other hand, all are aware that there are shortcomings in the program. Efforts are being made to improve it. To this end the present review should serve to provide sound knowledge of its organization to interested groups elsewhere as well as a framework around which a sound future program can be erected.

In order to assure that the full potentials of the Laboratory are realized it has been determined that the following are needed:

- 1) Additional staff with concomitant research support.
- 2) A large physiology laboratory housing controlled-conditions laboratories.
- 3) A major ocean-going vessel. Such a vessel is needed to permit the research and teaching staffs and students to occupy important stations over and beyond the Continental Shelf for extended periods of time. The ship should be so designed as to permit actual

field and laboratory experimental work at sea and not be restricted to the role of a mere collecting platform, important as that function is.

To this point it seems important that though the Laboratory can probably utilize most of the capacity of a large research vessel, i.e. about 185-230 feet LOA, for its own staff and students, it is also in an admirable situation geographically and logistically to serve in programming ship time for scientists from nearby areas. This may be of particular interest to groups from academic and research institutions in and around Richmond, Washington, and Baltimore.

4) Further development of a sound program of oceanographic and biological research. To permit this development certain major items of equipment are needed:

- a. Permanent recording oceanographic stations on light-houses and other over-water structures like bridges and Texas Towers. These will augment the activities of the research vessels.
- b. Rapid data storing and processing equipment. Both analog and digital computers will be useful.
- c. An electron microscope. This is necessary for particle analyses and virus and bacterial studies.
- d. An ultracentrifuge.

e. Several large items of oceanographic and laboratory equipment such as underwater television and advanced electrophoresis rig and ~~chromatographic~~<sup>chromatographic</sup> equipment.

5) Low-cost, perhaps self-amortizing, housing for married students and summer students and investigators.

6) Private and federally supported fellowships and assistantships.

The Commonwealth of Virginia will undoubtedly continue to improve its contribution to the marine research and teaching effort but it is evident that financial support from private philanthropy and federal agencies must be made available. An unlimited institutional grant would go a long way toward supporting additional basic research and promoting a well-rounded program. Perhaps an increased summer program could be financed in this way. Increased participation in federal grant-supported research would permit more efficient use of the time and talents of the scientific staff. Increased grant support of summer teachers, researchers and undergraduate and graduate students from elsewhere would assist in the training program. It seems obvious that with its present and potential attributes increased support for the Laboratory is easily justifiable.

T A B L E O F A P P E N D I C E S

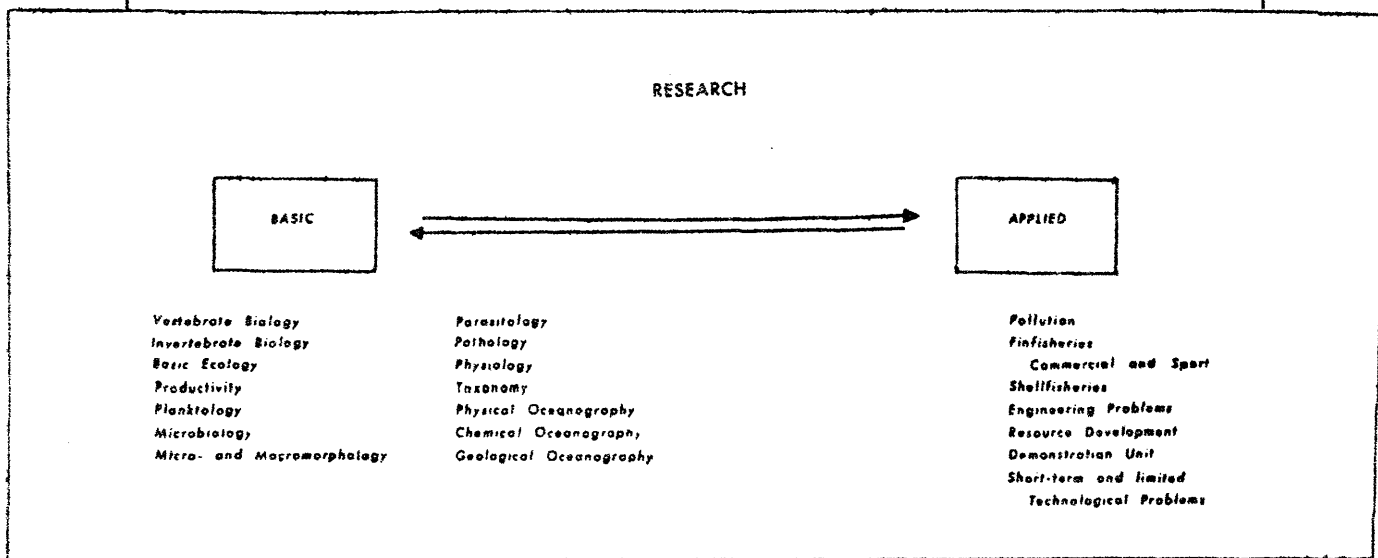
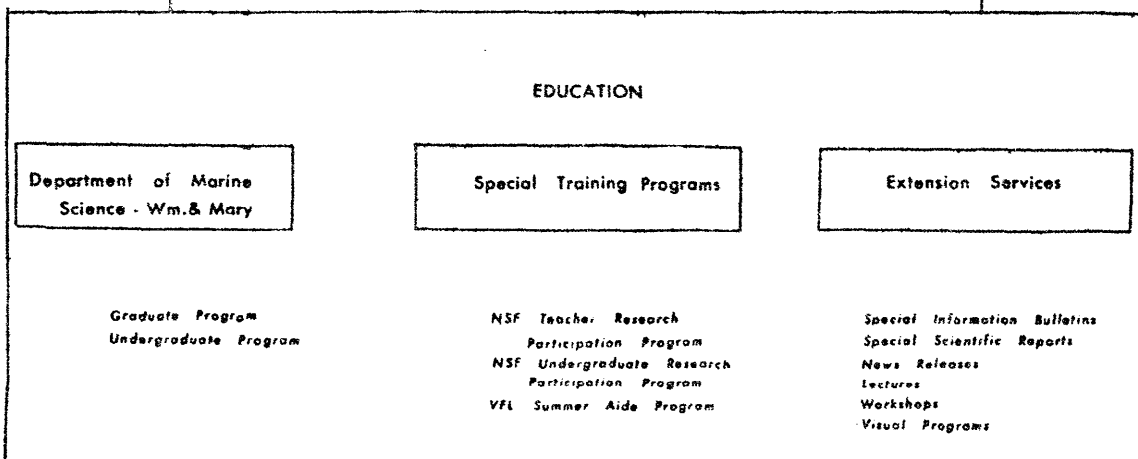
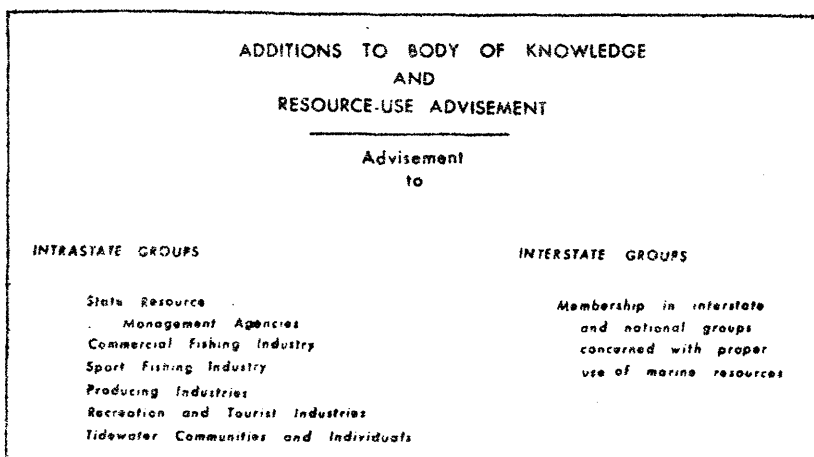
<u>Appendix</u>	<u>Subject</u>
I	Diagram Of Program
II	Charts and Maps
III	Laboratory Buildings
IV	Vessels
V	List of Equipment
VI	Organization and Personnel
VII	Finances
VIII	Research Program
IX	Faculty
X	Curriculum in Marine Science
XI	Graduate Students
XII	Flora and Fauna Checklist

APPENDIX I

DIAGRAM OF FUNCTIONS AND PROGRAM OF  
VIRGINIA FISHERIES LABORATORY  
(Virginia's Marine Laboratory)

# DIAGRAM OF FUNCTIONS AND PROGRAM OF VIRGINIA FISHERIES LABORATORY

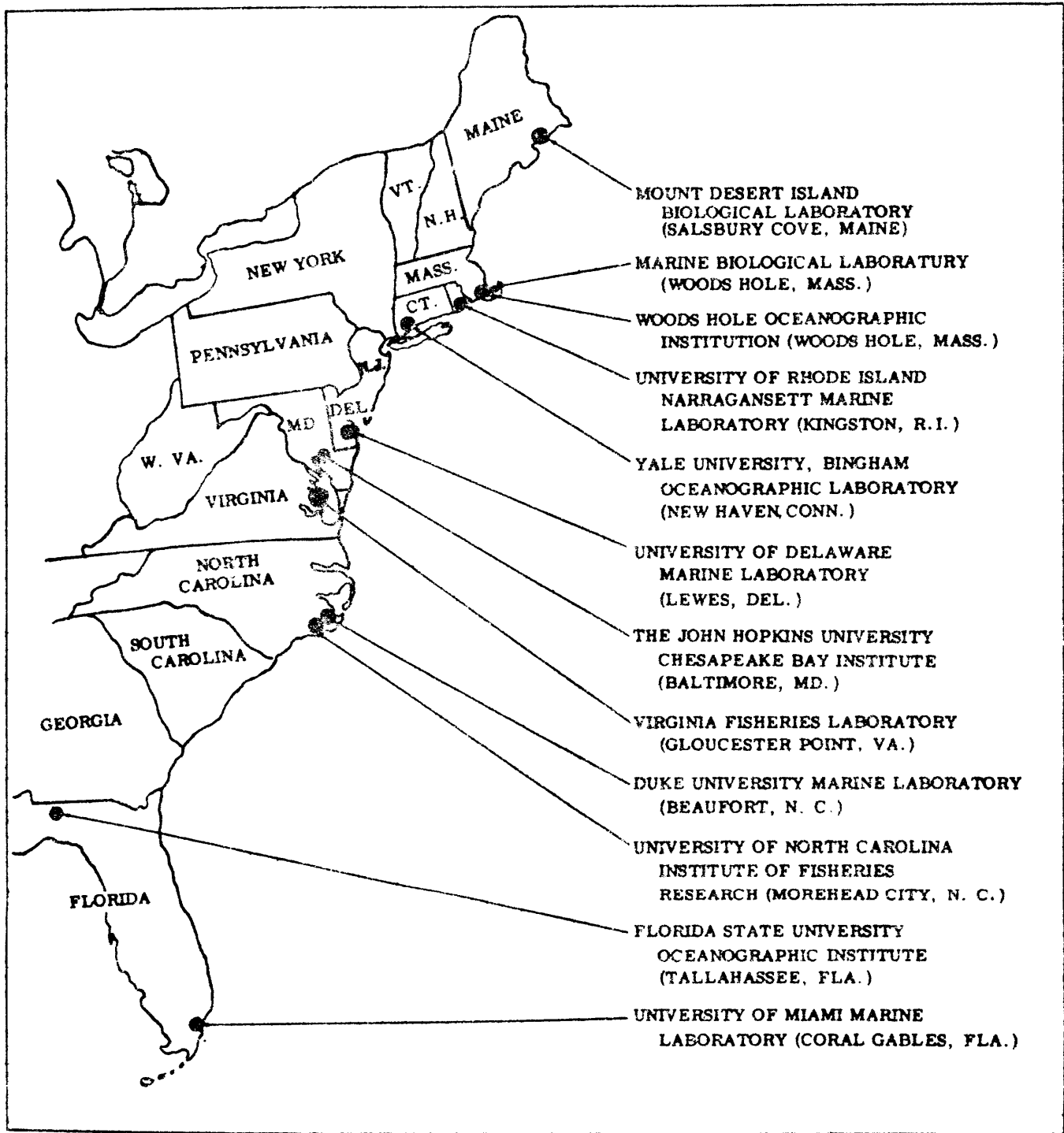
(Virginia's marine laboratory)

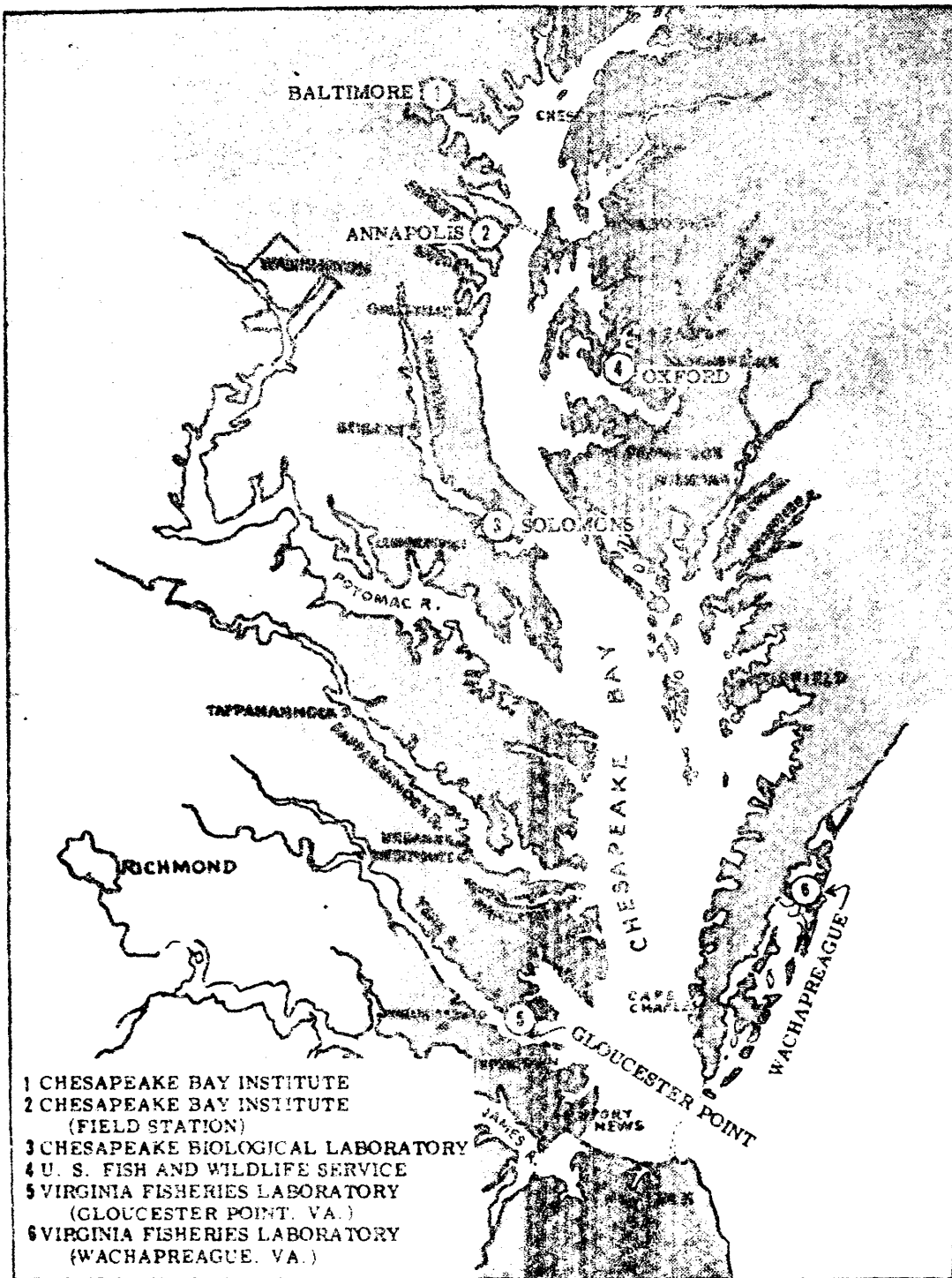


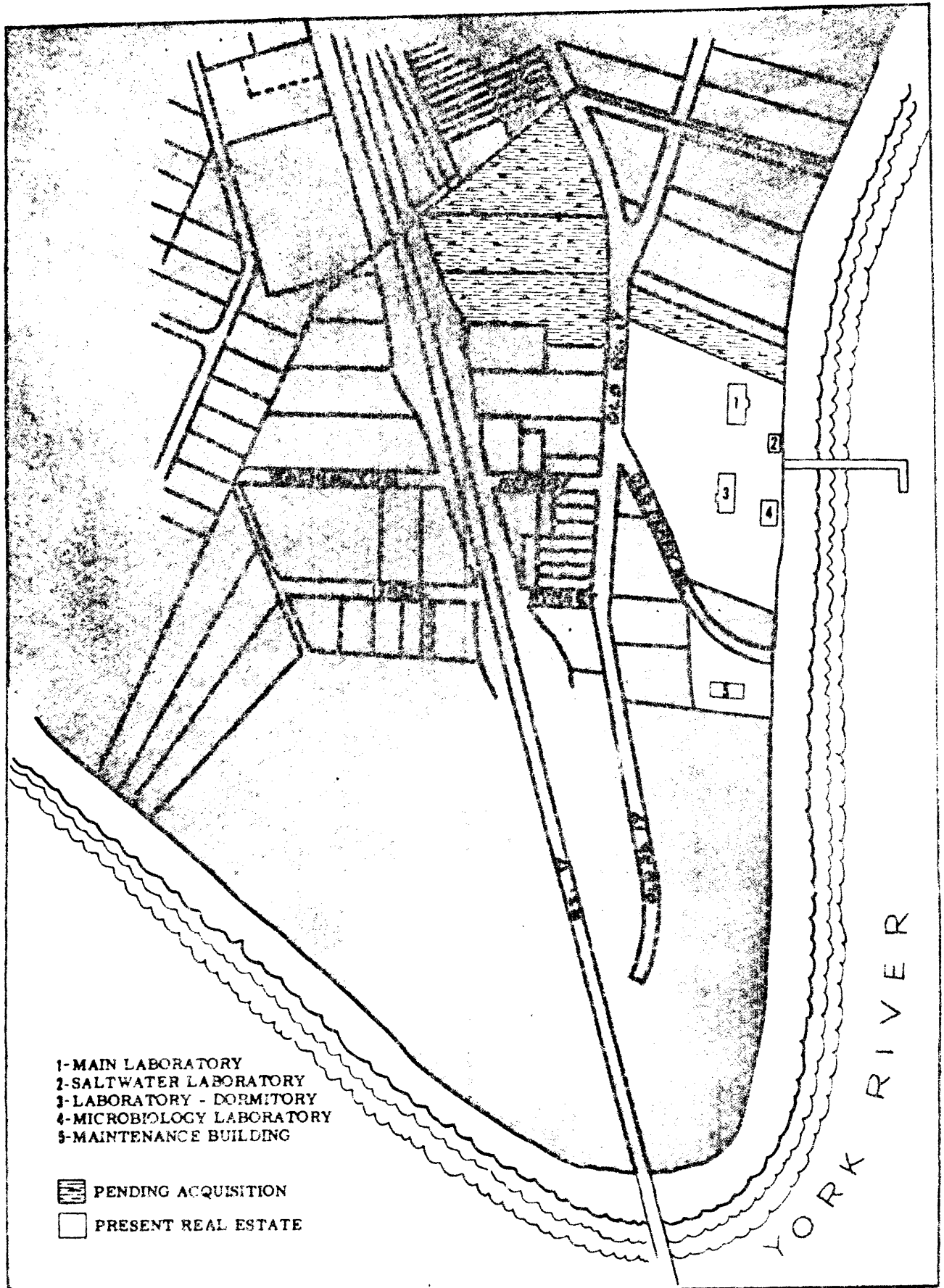
## APPENDIX II

### CHARTS AND MAPS SHOWING LOCATION OF LABORATORY

- Fig. 1. Chart showing location of Virginia's marine laboratory in relation to certain other academically associated marine laboratories on Atlantic Coast.
- Fig. 2. Chart showing laboratories located on Chesapeake Bay.
- Fig. 3. Map of Laboratory grounds and buildings.







## APPENDIX III

### LABORATORY BUILDINGS

Fig. 1. Aerial view of Laboratory grounds taken in 1959.

Fig. 2. Photographs of buildings at Gloucester Point (1961).

Detailed description of each of the buildings.





3 - LABORATORY-DORMITORY



1 - MAIN LABORATORY



2 - SALTWATER LABORATORY



4 - MICROBIOLOGY LABORATORY  
(Under construction Feb. 1961)



5 - MAINTENANCE BUILDING

MAIN BUILDING  
Completed 1950  
Gross area--6,400 sq. ft.  
Total cost, ca--\$150,000

I. SPECIFICATIONS

Running sea water  
Gas  
Air  
Partitions movable (walls not load-bearing)

II. ROOMS (As of October 1960) (Roman numeral indicates floor)

A. Class Rooms

1. Exhibit-Lecture Room--I (Accommodate 30-35 people)
2. Exhibit Preparation and Projection Room--I
3. Class Room-Laboratory--I (used for classes and research in summer and research in winter)

B. Offices

1. Information Office--I Bailey, Ashe
2. Director's Office--I Hargis
3. Reception Office--I Conner, Hudgins, Ashe
4. Asst. Admin. Dir. Office--I Washer
5. Research Secretary Office--II Hudgins
6. Sci. Office 1--II Andrews and group
7. Sci. Office 2--II Haven and group

C. Laboratories

1. Central Laboratory--II (Shared by Malacology, Microbiology, and several graduate students, and summer aides, at times as many as 8-12 people.)
2. Laboratory-Office 1--I Embryology Black and group
3. Laboratory-Office 2--II Parasitology Hargis and two students
4. Laboratory-Office 3--II Parasitology Sterling
5. Laboratory-Office 4--II Microbiology Emory and Turner
6. Laboratory-Office 5--II Microbiology Wood and group
7. Laboratory-Office 6--II Basic Ecology-Pollution Brehmer and group
8. Chemistry Lab--II (Shared, Brehmer and others.)
9. Constant Temp. Lab.--II (Shared, Andrews, Wood and others.)

## D. Others

1. Library--II (Wells and administrative secretaries)  
Part used for Mimeograph room.
2. Toilets (4)--I
3. Boiler Room--I
4. Dark Room--I Small dark room intended for staff use, not functional at the present time because the air conditioner had to be robbed for histology (Lab. - office 4--II) and we cannot replace it now.

## III. GROUPS (PERSONNEL) HOUSED IN BUILDING

## A. Administration

## 1. Administrative Staff

- |                            |          |
|----------------------------|----------|
| a. Director                | Hargis   |
| b. Confidential Secretary  | Conner   |
| c. Asst. Admin. Dir.       | Washer   |
| d. Stenographer            | Hudgins  |
| e. Sr. Information Officer | Bailey   |
| f. Jr. Information Officer | Biggs    |
| g. Stenographer            | Ashe     |
| h. Aide                    | Williams |
| i. Janitor                 | Jenkins  |

## B. Research Department with list of personnel in group or other persons accommodated in building.

## 1. Basic Ecology-Pollution Research Department

- |                       |                        |
|-----------------------|------------------------|
| a. Marine Scientist C | Brehmer                |
| b. Marine Scientist C | Wass-now in Annex Bld. |
| c. Marine Scientist A | AEC (1961)             |
| d. Marine Scientist A | authorized for 1961-62 |
| e. Lab. Tech.         | Wood, Jr.              |
| f. Student Asst.      | Eayrs                  |
| g. Grad. Asst.        | AEC                    |
| h. Grad. Asst.        | AEC (1961)             |

## 2. Molluscan Physiology Research Unit

- |                       |                   |
|-----------------------|-------------------|
| a. Marine Scientist C | Haven             |
| b. Lab. Tech. B       | not filled as yet |

## 3. Malacology Research Department

- |                       |                   |
|-----------------------|-------------------|
| a. Marine Scientist C | Andrews           |
| b. Marine Scientist A | not filled as yet |
| c. Lab. Tech. B       | Leigh             |
| d. Lab. Tech. A       | Crosswell         |
| e. Lab. Tech. A       | Walker            |
| f. Lab. Aide B        | Garnett           |

- |                                     |                |
|-------------------------------------|----------------|
| 4. Microbiology Research Department |                |
| a. Marine Scientist C               | Wood, Sr.      |
| b. Marine Scientist C               | Moskovits      |
| c. Marine Scientist A               | Mulford        |
| d. Lab. Spec. B                     | Emory          |
| e. Lab. Tech. B                     | Turner         |
| f. Grad. Asst.                      | Young          |
| 5. Parasitology Research Unit       |                |
| a. Marine Scientist A               | Sterling       |
| b. Res. Asst.                       | Nelson         |
| c. Res. Asst.                       | Morales-Alamo  |
| 6. Library                          |                |
| a. Librarian                        | Wells          |
| 7. Research Secretary               | Hudgins        |
| 8. Summer Aides                     | 10             |
| 9. Summer Students                  | 6-8            |
| 10. Visiting Groups                 | 5,000 per year |

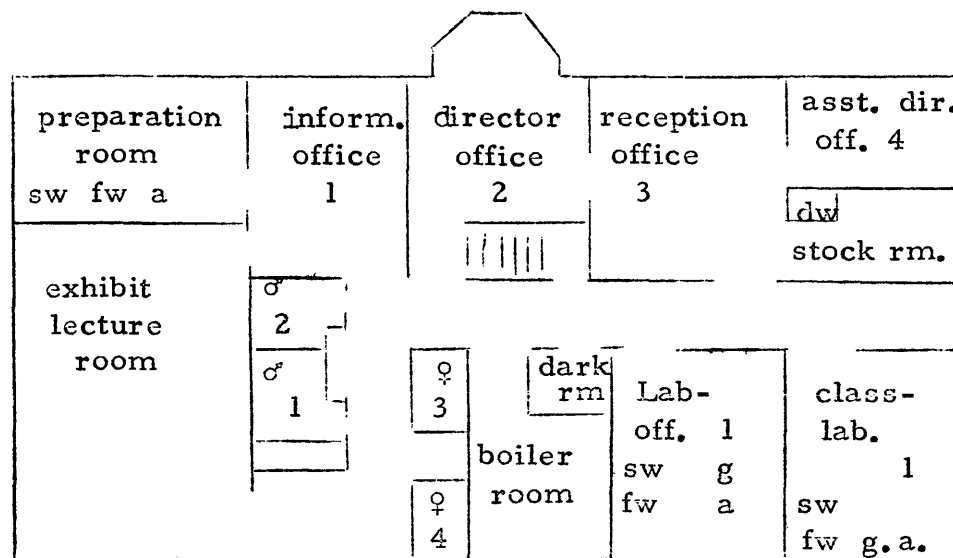
#### IV. PERSONNEL WHO SHOULD BE MOVED INTO THIS BUILDING

- A. Dr. Wass (Basic Ecology-Pollution) - now in Annex Building
- B. Marine Scientist A (Microbiology) will then move to Microbiology
- C. Marine Scientist A (Mollusk group)--not yet hired.
- D. Marine Scientist A (Basic Ecology-Pollution)
- E. Marine Scientist A (Basic Ecology-Pollution) - to be hired 1961-62
- F. Information Officer B

#### V. SPACE OR CONDITIONS REQUIRED IN MAIN BUILDING (or in a new building)

- A. Administrative
  1. Additional office space for administrative clerk and secretary.
  2. Greater stockroom space.
  3. An entire room which can be devoted to literature preparation (mimeograph).
- B. Research
  1. More space for library
  2. Additional office-laboratory space for expanding pollution group, for physical oceanography unit and for additional administrative people.
  3. Less-crowded conditions in main laboratory.
  4. More reliable salt-water supply in this and other buildings. Present system does not supply an adequate flow nor is it reliable. The primary reasons are poor design and the great head pressure that pumps must work against.
  5. Air conditioning (temperature, humidity and dust control).

MAIN BUILDING  
First Floor

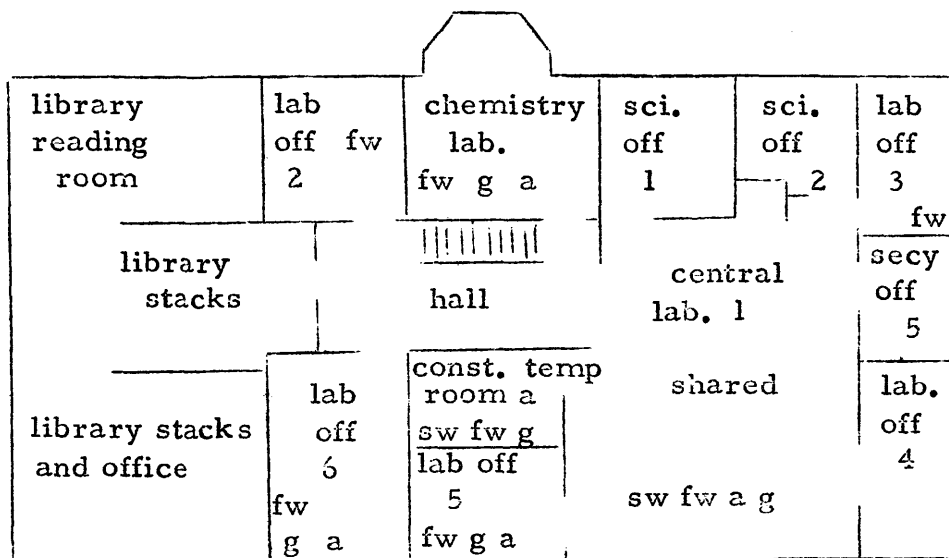


Symbols  
sw - salt water  
fw - fresh water  
g - gas  
a - air

Scale-- 1/16" = 1'

- A. Present use - described above.
- B. Plans for future use of space.
  1. Stock Room to office for assistant administrative director's secretary (Stock Room-Mimeograph Room, additional administrative clerks and typists, etc. to be moved upstairs.)
  2. Classroom which has been converted into a microbiology-parasitology laboratory may be converted into salt water laboratory for the entire building in an attempt to reduce the head, or back to a classroom.

MAIN BUILDING  
Second Floor



A. Present use - described above.

B. Plans for future use of space.

1. Histology Group will move from Lab-Office 4 to Microbiology Building. Lab-Office 4 will then be used for Marine Sci. A (mollusc culture man).
2. Dr. Wood to move to Microbiology Building. Lab-Office 5 to be used by Mar. Sci. A (Ecology-Pollution).
3. Dr. Brehmer to move to Radiobiology Lab. Lab-Office 6 to be used by Dr. Wass (Ecology-Pollution).
4. Library to remain as is until more adequate space is provided in the proposed Physiology Research Building, at which time it will be converted to administrative and scientific office space. (Physical Oceanography group may also be located here.)
5. Space vacated by Ecology-Pollution research section will be occupied by embryology, genetics and parasitology when proposed Physiology Research Building is built.

ANNEX BUILDING  
 Completed 1958  
 Gross area--7,618 sq. ft.  
 Total cost, ca--\$98,000

## I. SPECIFICATIONS

No running sea water  
 Gas)  
 Air) added after construction  
 Partitions fixed

## II. ROOMS ( As of October 1960) (Roman numeral indicates floor)

## A. Class Rooms

1. Class Room - Lab. 2--I, (Year-round student use 5-15 people)

## B. Offices

- |     |  |   |
|-----|--|---|
| 1.  | Research Secy's. Office--II                                | Jordan  |
| 2.  | Graduate Office--I   | (6 students)  |
| 3.  | Sci. Office 1--I Ichthyology                               | Joseph  |
| 4.  | Sci. Office 2--II Carcinology                              | Wojcik  |
| 5.  | Sci. Office 3--II Ichthyology                              | Massmann  |
| 6.  | Sci. Office 4--II Carcinology                              | Van Engel   |
| 7.  | Sci. Office 5--II Oyster Drill Unit                        | Whitcomb  |
| 8.  | Sci. Office 6--II Ichthyology                              | Norcross  |
| 9.  | Sci. Office 7--II Ichthyology                              | Richards  |
| 10. | Sci. Office 8--II Pollution and<br>Microbiology<br>Section | (Wass, Moskovits<br>temporarily, was<br>dormitory room) |

## C. Laboratories

1. Laboratory 1--I Radioactivity Laboratory. Was gear storage room, now being converted for AEC-sponsored research projects. (Brehmer and associates).
2. Laboratory 2--I Planktology (Patten, Warinner Isaacson, etc.)
3. Laboratory 3--II Ichthyology (Joseph, Massmann, Norcross, Richards, Grant, Carmine and other graduate students and summer aides and students.)

4. Laboratory 4--II Carcinology(crab) (Van Engel, Wojcik, Jenkins, Handley, Tan and other graduate students and summer aides and students).
5. Illustration Laboratory--I (Bailey, et al, was dormitory room)
6. Photography laboratory and Dark Room--I (Bailey, et al.)

## D. Dormitories

1. Dormitory 1--I 2 students
2. Dormitory 2--I 3 students
3. Dormitory 3--II 1 biologist (may have to be converted to office use for several years).
4. Dormitory 4--II 2 students

## E. Other

1. Galley--II (Built for 10-12, serves 30-40 in summer, 12 in winter)
2. Dining Room-Lounge--II (Built for 10-12, serves 30-40 in summer, 12 in winter.)
3. Toilets, 5--one on I and four on II
4. Shower--I
5. Boiler Room--I
6. Fish Collection Room--I (Ichthyology and Carcinology)
7. Dining and est Room for help--II

## III. GROUPS HOUSED IN BUILDING

## A. Administrative

1. Photographer--Information Officer (Bailey and Aide)

## B. Research Groups

1. Basic Ecology-Pollution Research Department
  - a. Marine Scientist C Brehmer (Radiobiology lab.)
  - b. Marine Scientist C Wass
2. Carcinology (crab) Research Department
  - a. Marine Scientist C Van Engel
  - b. Marine Scientist B Wojcik
  - c. Lab. Aide B Jenkins
  - d. Grad. Asst. Tan
  - e. Clerk Typist B Handley
3. Ichthyology Research Department
  - a. Marine Scientist C Joseph
  - b. Marine Scientist C Massmann
  - c. Marine Scientist B Norcross
  - d. Marine Scientist B Richards
  - e. Lab. Tech. A Carmine
  - f. Grad. Asst.

4. Planktology Research Department	
a. Marine Scientist C	Patten
b. Grad. Asst. 1	Warinner
c. Grad. Asst. 2	Isaacson
d. Research Asst.	Eayrs
5. Oceanography Research Department	
a. Marine Scientist C	Authorized but not yet hired.
6. Research Secretary	Jordan
7. Summer Professors	6
8. Graduate Students	11
9. Summer Aides	10
10. Summer Students	6-13

#### IV. PERSONNEL WHO SHOULD BE MOVED INTO BUILDING

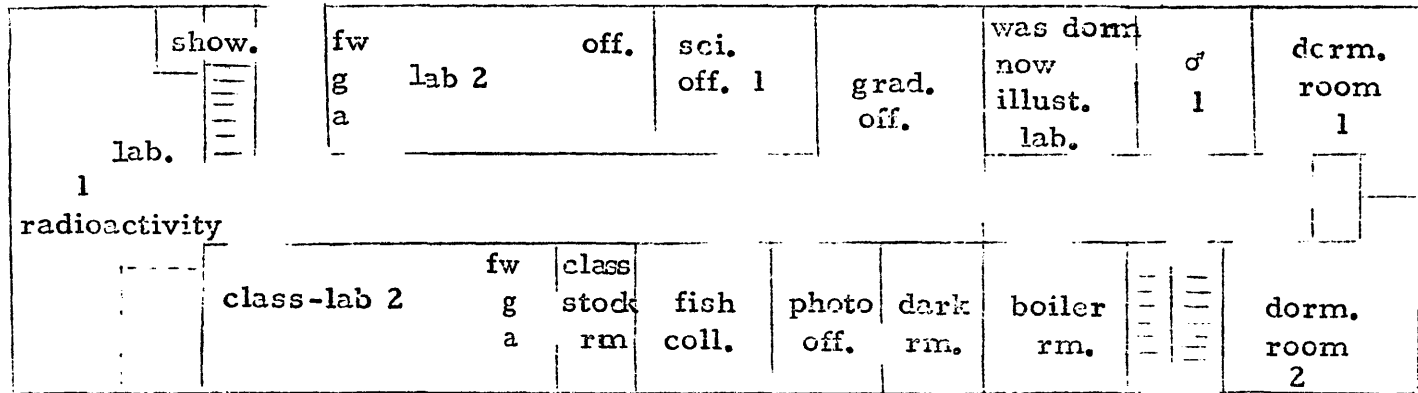
- A. Oceanographer - when hired
- B. Additional Graduate Students

#### V. SPACE OR CONDITIONS NEEDED IN ANNEX BUILDING

- A. More dormitory space for year-round graduate students and summer students.
- B. More adequate galley-dining facilities. Must be adequate to feed up to 60 people in summer and 20 in winter.

This building is not really adequate as an experimental laboratory because salt water was not provided and because the research offices do not even have fresh water. It should be converted almost entirely to dormitory and student services. The remainder of the building, not used for those purposes should be converted for use of research units not requiring wet laboratories such as Statistics, Physical Oceanography, and computer service.

ANNEX BUILDING  
 First Floor  
 32' x 119'



Symbols

fw - freshwater  
 g - gas  
 a - air

- A. Present use - described above
- B. Plans for future use of space.

1. Lab. 1,--Radioactivity Laboratory will be converted to Dining Room.
2. One-half of the Class Lab. 2 will be made into Galley. (Class-Laboratory will be located in proposed new Marine Pollution and Physiology Research Building.)
3. Illustration Laboratory and Graduate Office will revert to dormitory space.

ANNEX BUILDING  
Second Floor  
32' x 119'

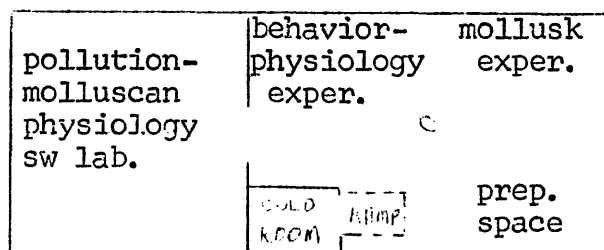
fish lab 3	fw	-- --	sci. off.	sci. off.	sci. off.	Dorm. rm.	dorm rm.	4 ♀	galley	dining area
	♂	-- --	2	3	4	3	4			
crab lab 4	♀	secy	sci. off.	sci. off.	sci. off.	dorm. rm. now sci. off. 8	help dining rm.	5 ♂	-- --	lounge
	fw		5	6	7	-- --	-- --			

Symbol

fw - fresh water

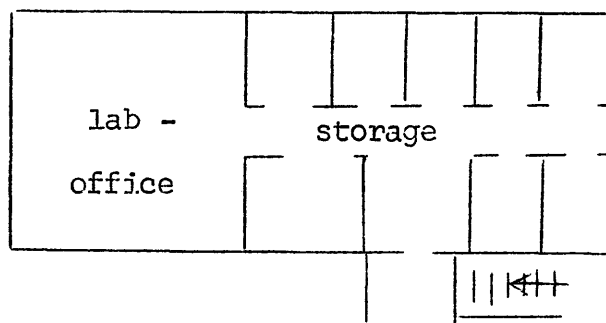
Plans for future use of space:

1. Sci. Office 8 will revert to use as Dormitory Room.
2. Several of present science offices will become dormitories.
3. Some of the other science offices may become graduate offices.
4. Laboratories 3 and 4 may become graduate laboratories.
5. Dining area and Lounge will be used for seminars, Board meetings, committee meetings, faculty meetings and special functions in addition to providing additional dining space as needed. It will continue to serve as student lounge.



fw = fresh water  
sw = salt water  
a = air

1st Floor



Scale 1/16" = 1'

2nd Floor

Built as shop in 1950. Originally 20' x 30'. Enlarged 1961 to 20' x 50'.

A. Present use

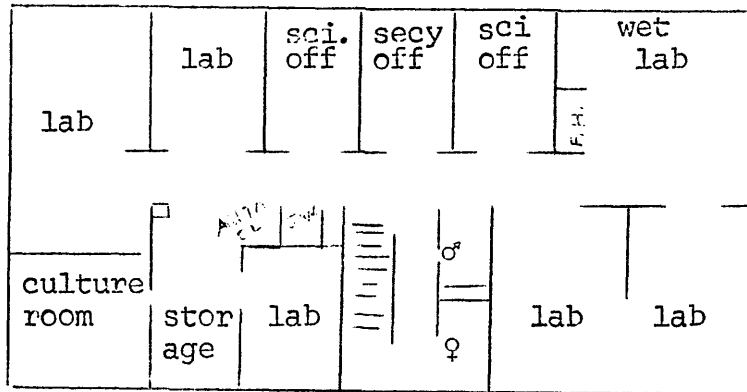
1. Originally used as maintenance shop. Enlargement of scientific staff made employment as research space necessary in 1961.
2. First floor has 8 wet tables with hot and cold running sea and fresh-water. Also wet specimen preparation space and cold storage room.
3. Most of second floor used for storage.
4. Part of second floor being used for laboratory and office space.

B. Future use

1. Entire first floor turned over to culture laboratory when physiology, toxicology and behavior studies go to controlled conditions salt-water laboratories in proposed new Marine Pollution and Physiology Research Building in 1963-64.
2. Entire second floor revert to much needed light gear storage space. Needed here because of proximity to dock and boat activities.

MICROBIOLOGY BUILDING

Gross Area  
 Basement = 1,984  
 1st Floor = 1,984  
 Total = 3,868



1st Floor  
 (Basement - Four large rooms)

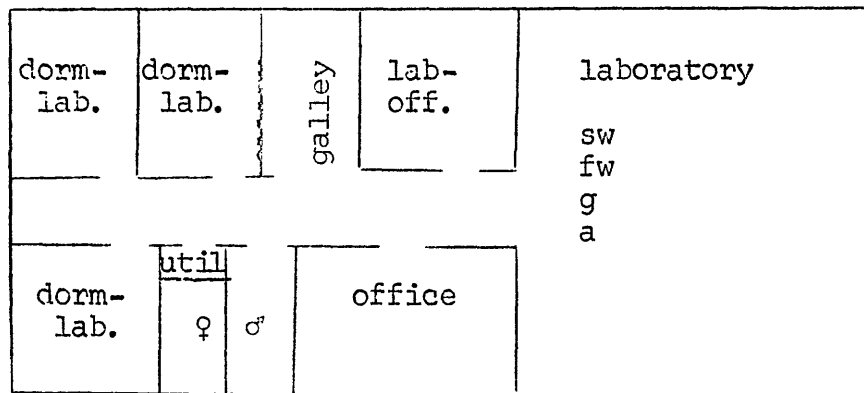
A. Present use

1. Currently under construction, expect to be in service by summer 1961.
2. Will house Microbiology Department consisting of:
  - a) Dr. J. L. Wood, Department Head
  - b) Dr. G. Moskovits, Associate Biologist
  - c) Mr. Richard A. Mulford, Assistant Biologist
  - d) Mrs. Dorothy K. Emory, Chief Technician
  - e) Miss Patricia Turner, Technician
  - f) Mr. David Young, Graduate Assistant
  - g) Research Secretary
3. In addition, from 1 to 8 persons in summer.
4. Basement - 4 laboratories, specimen storage and specimen preparation rooms - 15 liter int'l. centrifuge.
5. Roof - Algae culture (sw, fw, g, a).

B. Future use

1. Add second floor for laboratories.

EASTERN SHORE LABORATORY  
 Wachapreague, Virginia  
 (Access to true salt marshes, embayments, and  
 barrier beaches of Virginia's Atlantic Coast)  
 Gross area - 3,068 sq. ft.



Scale 1/16" = 1'

sw = salt water  
 fw = fresh water  
 g = gas  
 a = air

Use - Now under construction

A. Present

1. House 5 persons staff (1961-1962) as follows:
  - a) 2 scientists
  - b) 2 technicians
  - c) 1 secretary

2. Will be able to house 12 students and/or scientists

B. Future

1. Will eventually house at least 6 permanent people and 3 summer assistants.
2. Summer researchers and field-trip personnel will also use plant.

## APPENDIX IV

### VESSELS

- Fig. 1. Aerial view of RV PATHFINDER
- Fig. 2. View of RL OBSERVER
- Fig. 3. Antarctic research vessel OCTANS, built to laboratory specifications by National Science Foundation. Will remain at Wilkes Station when current project is completed.





RESEARCH LAUNCH "OBSERVER"



ANTARCTIC RESEARCH VESSEL "OCTANS"

## APPENDIX V

### LIST OF EQUIPMENT

In addition to the usual laboratory equipment and supplies, special items are:

Phase microscopes (5)

Fluorescent microscope

Temperature-controlled Warburg apparatus

Refrigerated centrifuge

Serum centrifuge

Freeze-drying equipment

Radiation detectors and counting devices

Amperometric chlorinity titrator

DU Beckman spectrophotometer (with flame and ultraviolet attachments)

Electrical scale reader

Eppley pyrheliumeter with recording and read-out devices

Tidal gauge and continuous temperature recorder

CBI instantaneous conductivity and temperature indicator

Thermistor probes

Precision current meter

High speed plankton samplers

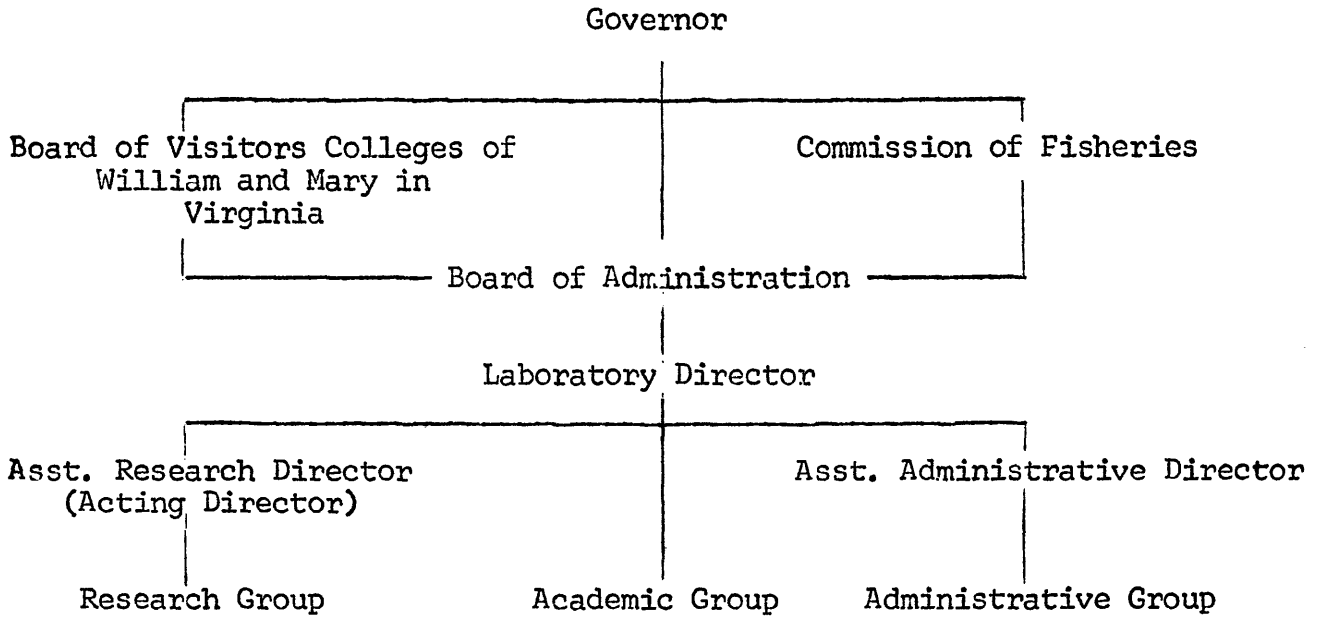
## APPENDIX VI

### ORGANIZATION AND PERSONNEL

- Section 1. Chart of general organization
- Section 2. Departmental organization showing personnel in actual numbers and full-time equivalents.
- Section 3. Personnel.
- Section 4. Signatory officials.
- Section 5. Personnel 1962-1968.

Section 1

Chart of Organization



## Section 2

### Departmental Organization Showing Personnel in Actual Numbers and Full-time Equivalentents

#### I. Research Group

##### A. Research Departments

(FTE = Estimation full-time equivalentents)

	Personnel Involved (minimum)			
	<u>1961</u>	<u>FTE</u>	<u>1962</u>	<u>FTE</u>
1. Carcinology Research Department (Research Assistant shared with Ichthyology)	4 1/2	4	(unless otherwise noted effort to be same in 1962)	
2. Basic Ecology-Pollution	5	4 1/2	-	-
3. Eastern Shore Laboratory	2	2	4-5	4-5
4. Ichthyology	6 1/2	6	-	-
5. Malacology	6	6	-	-
6. Microbiology-Pathology	6	5 1/2	-	-
7. Oceanography	1	1	2(?)	2
8. Physiology	-	-	3	3
9. Planktology	4	2 1/4	-	-

##### B. Special Project Units

1. Molluscan Physiology	2	2	-	-
2. Oyster Drill Research	2	1 2/3	4	3 1/2
3. Parasitology	7	5	-	-
4. Embryology (Dr. Black)	1	1	-	-
5. Digenetic Trematodes (Dr. M. Byrd - W & M)	1	2/3	-	-
Sub-total	48	41 1/2	56	47 1/2

	<u>1961</u>	<u>FTE</u>	<u>1962</u>	<u>FTE</u>
C. Other Groups				
1. Library	2	1 1/4	-	-
2. Summer Scientists	6	1 1/2	-	-
3. NSF Undergraduate Research Participants	10	2 1/2	-	-
4. NSF College Teacher Research Participants	7	1 3/4	-	-
5. VFL Summer Aides	10	2 1/2	-	-
	<hr/>	<hr/>	<hr/>	<hr/>
Sub-total	28	9 1/2	28	9 1/2
II. Administrative Groups				
A. Director's Office	2	2	-	-
B. Asst. Adm. Director's Office	3	2 1/2	-	-
C. Research Group Stenographers	3	3	4(?)	4
D. Public Education	4	3 1/4	-	-
E. Maintenance	9	7	-	-
F. Vessel Operations	2	2	-	-
G. Summer Services	3	7(?)	-	-
	<hr/>	<hr/>	<hr/>	<hr/>
Sub-total	26	20 3/4	27	21 3/4
Grand Total Laboratory Personnel	102	71 3/4	111	78 3/4
	<hr/> <hr/>	<hr/> <hr/>	<hr/> <hr/>	<hr/> <hr/>

III. Academic Group

(Most personnel same as research staff  
therefore not in grand total)

	<u>1960</u>	<u>1961</u>
A. Professors	2	6
B. Associate Professors	10	6
C. Assistant Professors	3	3
D. Summer Professors	4	4
E. Associate Members	<u>3</u>	<u>6(?)</u>
	21	25

## Section 3

### Personnel

#### Board of Administration

Davis Y. Paschall	<u>President of the College of</u>
Milton T. Hickman	<u>William and Mary, Co-Chairman</u>
R. L. Miles, Jr.	<u>Commissioner of Fisheries,</u>
James E. Mays	<u>Co-Chairman</u>
Robert W. Ramsey	Norfolk, Virginia
William J. Hargis, Jr.	Norfolk, Virginia
	Richmond, Virginia
	<u>Secretary of the Board</u>

#### Scientific Staff

William J. Hargis, Jr., Ph.D. <sup>1</sup>	Director
J. D. Andrews, Ph.D. <sup>1</sup>	Senior Marine Scientist
Morris L. Brehmer, Ph.D. <sup>2</sup>	Senior Marine Scientist
Edwin B. Joseph, Ph.D. <sup>1</sup>	Senior Marine Scientist
W. A. Van Engel, Ph.M. <sup>2</sup>	Senior Marine Scientist
John L. Wood, Ph.D. <sup>2</sup>	Senior Marine Scientist
Robert E. L. Black, Ph.D. <sup>4</sup>	Associate Marine Scientist
Dexter S. Haven, M.S. <sup>2</sup>	Associate Marine Scientist
William H. Massmann, M.A. <sup>3</sup>	Associate Marine Scientist
George Moskovits, Ph.D. <sup>2</sup>	Associate Marine Scientist
Bernard C. Patten, Ph.D. <sup>2</sup>	Associate Marine Scientist
Marvin L. Wass, Ph.D. <sup>2</sup>	Associate Marine Scientist
Robert S. Bailey, M.A. <sup>3</sup>	Assistant Marine Scientist
Hinton D. Hoese, M.S.	Assistant Marine Scientist
John J. Norcross, M.S. <sup>3</sup>	Assistant Marine Scientist
Clarence E. Richards, M.S.	Assistant Marine Scientist
James P. Whitcomb, B.A.	Assistant Marine Scientist
Frank J. Wojcik, M.S.	Assistant Marine Scientist
Evelyn C. Wells, M.S.	Research Librarian
Reinaldo Morales-Alamo, B.S.	Research Assistant
Richard A. Mulford, B.S.	Research Assistant
William Y. Saunders	Research Assistant
James S. Sterling, B.S.	Research Assistant
Stanley W. Wilson, B.S.	Research Assistant
Dorothy K. Emory	Marine Microtechnician
Patricia A. Turner	Assistant Microtechnician
Curtis C. Leigh	Marine Technician
Bernice D. Carmine	Laboratory Aide
Clarence J. Croswell	Laboratory Aide
William T. Davis	Laboratory Aide
Helena J. Garnett	Laboratory Aide
Charles Jenkins	Laboratory Aide
Franklin B. Walker	Laboratory Aide
John L. Wood, Jr.	Laboratory Aide

Summer Scientists

Willis G. Hewatt, Ph.D. <sup>4</sup>	Associate Marine Scientist
Sewell H. Hopkins, Ph.D. <sup>4</sup>	Associate Marine Scientist
Neil C. Hulings, Ph.D. <sup>4</sup>	Associate Marine Scientist
Jacques S. Zaneveld, Ph.D. <sup>4,5</sup>	Associate Marine Scientist

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- 1--Also Professor of Marine Science  
2--Also Associate Professor of Marine Science  
3--Also Assistant Professor of Marine Science  
4--Summers only  
5--Also Professor of Biology in the Norfolk Division of William and Mary.
- 

Scientific positions newly established but not yet filled:

Associate Marine Scientist	to serve in/as	Physical Oceanographer
Research Assistant	"	Culture Specialist
Laboratory Aide	"	Molluscan Physiology Dept.

Administrative Group

W. J. Hargis, Jr.	Laboratory Director
R. J. Washer, B.S.	Asst. Administrative Director
Miss Patricia R. Conner	Confidential Secretary

Administrative Secretaries

Miss Anita Dale Hudgins  
Mrs. Charlotte Ashe

Research Secretaries

Mrs. Judy Hudgins  
Mrs. Audrey Jordan  
Mrs. Mollie McMurtrie

Clerk Typist

Mrs. Jennie S. Handley

Information Office

Robert S. Bailey  
Fred C. Biggs  
Mrs. Beverly Ashe

Information Officer  
Asst. Information Officer  
Secretary

Maintenance Group

Thomas A. Chapman  
William E. Lewis  
Hayes Bolden  
Walter Kelly  
Dick Vrolijk  
Mrs. Freddie Boyd  
Mrs. Thelma Stokes  
Mrs. Carrie Jenkins

Buildings & Grounds Supervisor  
Marine Equipment Repairman  
Utility Serviceman  
Utility Serviceman  
Carpenter  
Maid  
Maid  
Housekeeper

Vessel Group

Richard J. Hochban  
Vessel mate

Oceanographic Research  
Vessel Captain  
(to be hired)

PERSONNEL

Category	1940-42	1942-44	1944-46	1946-48	1948-50	1950-52	1952-54	1954-56	1956-58	1958-60	Summer 1960
Scientific	6	?	5	3	5	6	6	9	11	18	21
Administrative	1		1	1	3	3	3	3	4	5	7
Maintenance	1				1	2	2	2	3	4	4
Lab. Aides			1	1	1			1	1	6	9
Grad. Students	1			1	2	5	3	5	2	3	8
Summer Aides					2	2	2	7	8	7	11
Summer Prof. 's						2	3	2	3	3	4
Summer Maint.									2	2	3
N.S.F. Students									22	22	22
Visiting Prof. 's			1	1					1	1	3
Summer Students				1	1	7		3	5		3
Boat Captain	1		1	1							
Totals	10	?	9	9	15	27	19	32	62	71	95

Section 3  
Personnel

Section 4

Signatory Officials

Officials authorized to sign for institution:

Mr. Roy J. Washer  
Assistant Administrative Director  
Virginia Fisheries Laboratory

Phone: Office Midway 2-2100  
Home Midway 2-3380

or

Dr. William J. Hargis, Jr.  
Director  
Virginia Fisheries Laboratory

Phone: Office Midway 2-2100  
Home Midway 2-3612

Financial Officer: Mr. Roy J. Washer

Section 5

Personnel 1962-1968

The following personnel additions are planned for the period 1962-1968. Though the ratings and numbers may, of course, be altered, the Board of Administration has approved the list. Should increased federal research grant and facility funds become available, other additions will be possible; indeed, some, e.g. vessel operations, will be mandatory.

<u>Categories and Departments</u>	<u>Biennium 1962-64</u>	<u>Biennium 1964-66</u>	<u>Biennium 1966-68</u>	<u>Total</u>
Salaried Personnel				
Associate Marine Scientist	10	2	-	12
Assistant Marine Scientist	5	-	-	5
Research Assistant	3	2	-	5
Research Aides	8	5	-	13
Research Services	3	-	1	4
Vessel Operations	5	5	-	10
Maintenance	8	3	-	11
Stenographic	8	1	-	9
Totals	50	18	1	69
-----				
Waged Personnel				
Student Assistants	3	3	3	9
Cook & Helper	-	2	-	2
Totals	3	5	3	11
GRAND TOTAL All Personnel	53	23	4	80

APPENDIX VII

FINANCES

Section 1. History of General Fund Financing

Section 2. History of Grant Financing

## Section 1

## GENERAL FUND FINANCING

<u>Dates</u>	<u>M &amp; O</u>	<u>Capital Outlay</u>	<u>Total</u>
1940*	\$ 4,886.96	\$ -	\$ 4,886.96
1941*	4,777.32	-	4,777.32
1942*	5,462.36	-	5,462.36
1943*	4,789.57	-	4,789.57
1944*	7,396.52	11.56	7,408.08
1945	25,424.37	5,419.74	30,844.11
1946	30,650.25	4,325.56	34,975.81
1947	20,301.96	1,056.75	21,358.71
1948	31,796.48	13,204.40	45,000.88
1949	72,431.39	19,099.47	91,530.86
1950	76,060.58	144,235.53	220,296.11
1950-52	172,651.96	3,595.84	176,247.80
1952-54	194,590.00	10,850.00	205,440.00
1954-56	247,602.21	21,979.93	269,582.14
1956-58	275,300.00	107,400.00	382,700.00
1958-60 Reg. Appropriation:			
405,750.00		12,910.00	418,660.00
1959 Special Appropriation:			
52,400.00		6,420.00	<u>58,820.00</u>
			<u>477,480.00</u>
1960-62	698,700.00	127,500.00	
Transfer from Gov.'s Fund:			
Salaries-----	<u>45,000.00</u>		
For Land Purchase-----		<u>31,000.00</u>	
	743,700.00	<u>158,500.00</u>	902,200.00

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\* 1940 - 1944 Under the Commission of Fisheries, Newport News, Virginia.

We understand that the College contributed similar small amounts of money during this period, but as yet have been unable to determine exactly how much.

Section 2

G R A N T S

SHAD INVESTIGATIONS J. L. McHugh	American Viscose Corporation
1951--All Expenses, Equipment & salaries of field investigators	No Set Amount
-----	
HAMPTON ROADS BRIDGE-TUNNEL J. D. Andrews	State Highway Department
1955--All Expenses, Equipment & salary of field aide.	No Set Amount
-----	
A STUDY OF OYSTER DRILLS IN CHESAPEAKE BAY J. D. Andrews and J. L. McHugh Principal Investigator, W.J. Hargis, Jr.	U. S. Fish & Wildlife Service
1955-56 8,240	\$24,000
1956-57 7,760	
1957-58 8,000	
-----	
A STUDY OF OYSTER DRILLS IN CHESAPEAKE BAY (Cont'd) W. J. Hargis, Jr., renewed in 1958-59	U. S. Fish & Wildlife Service
	\$12,190
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A STUDY OF OYSTER DRILLS IN CHESAPEAKE BAY (Cont'd) W. J. Hargis, Jr., renewed in 1959-60	U. S. Fish & Wildlife Service
	\$10,000
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PILOT SCALE OYSTER PROCESSING STUDY Richard Edge and Arnold Tubman	U. S. Fish & Wildlife Service U. S. Pure Food & Drug Admis.
1958-59 2,645	\$ 6,996
1959-60 3,550	
1960-61 800	
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HOST SPECIFICITY OF MONOGENETIC TREMĀTODES	National Institutes of Health
William J. Hargis, Jr.	\$26,613

1958-59	11,599
1959-60	7,441
1960-61	7,573

A STUDY OF ECTO- AND ENDO- PARASITES OF ANTARCTIC FISHES	National Science Foundation
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W. J. Hargis, Jr. & Stanley Wilson 1959-60	\$10,435
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A STUDY OF CERTAIN PARASITES OF ANTARCTIC VERTEBRATES AND INVERTEBRATES 1960-62	National Science Foundation
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W. J. Hargis, Jr. & Stanley Wilson	\$40,432
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TEACHER TRAINING PROGRAM	National Science Foundation
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Robert S. Bailey - 1959	\$16,030
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TEACHER TRAINING PROGRAM	National Science Foundation
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Robert S. Bailey - 1960	\$21,525
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UNDERGRADUATE STUDENT PARTICIPATION PROGRAM	National Science Foundation
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Robert S. Bailey - 1959	\$ 8,250
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UNDERGRADUATE STUDENT PARTICIPATION PROGRAM	National Science Foundation
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Robert S. Bailey - 1960	\$ 8,055
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APPENDIX VIII

RESEARCH PROGRAM

Section 1. List of Laboratory Projects

Section 2. List of Current Grant-Supported Projects.

## Section 1

### List of Laboratory Projects

(Impending Projects indicated by asterisk)

#### I. Research Departments

##### A. Basic Ecology-Pollution

1. Role of periphyton in basic productivity of York estuary.
2. Ecological survey of benthos in estuarine areas.
3. Pre-use site ecological survey. (Study of sites proposed for nuclear vessel operations.)
4. Productivity of benthic communities.
5. Studies of effects of thermal discharges on benthic communities.
6. Bay-wide radioactivity monitoring program. Study of uptake of radioactive particles by selected segments of the flora and fauna.

##### B. Carcinology

1. Life history and ecology of Callinectes sapidus, the blue crab.
2. Dynamics of blue crab stocks.
3. Collection of commercial crab catch records.
4. Development of a self-culling crab pot.
5. Survey of Crustacea of Chesapeake Bay.
6. Studies of planktonic Crustacea of Continental Shelf.
- \*7. Improvement of commercial crabbing gear and practices.

##### C. Eastern Shore Laboratory

1. Survey of mortalities in marine invertebrates, primarily mollusks.
2. Preliminary studies of the ecology of the seaside area.
3. Studies of reasons for absence of Dermocystidium on Seaside; also role of scavengers in transmission.
4. Winter kill of various races of oysters under various intertidal conditions.

##### D. Ichthyology

1. Study of the ichthyoplankton of the Continental Shelf.
2. Preliminary study of oceanography of Continental Shelf off Virginia.
3. Study of morphology and development of the embryos of selected marine fishes.

4. Studies of culture techniques suitable for laboratory rearing of marine fish larvae.
5. Ecology of selected marine fishes.
6. Continuing survey of marine fishes of Chesapeake Bay and nearby Atlantic waters.
7. Survey of the Chesapeake Bay Sport Fishery.
8. Offshore big-game fish investigations.
9. Commercial sampling program.
- \*10. Study of sound production by marine fishes.
- \*11. Study of certain aspects of behavior in selected marine fishes.

E. Malacology

1. Epidemiology of diseases of bivalves of Chesapeake Bay.
2. Extensive collections of mortality data for oyster populations.
3. Biology of Dermocystidium marinum, a fungus parasite of molluscs.
4. Biology of Crassostrea virginica, the Atlantic oyster.
- \*5. Selection and breeding of bivalve populations with desirable characteristics.
- \*6. Development of techniques for laboratory culture of delicate bivalves.
7. Ecology and taxonomy of molluscs of Virginia's tidal waters.
8. Annual survey of public oyster grounds for population characteristics.
9. Annual records of spatfall in various Virginia tributaries (special collectors distributed and collected each year).
10. Biology of parasites of mollusks.
11. Growth of oysters under various experimental and natural conditions.
12. Continuing survey of fouling organisms.

F. Microbiology-Pathology

1. Survey of agents producing mortalities in marine vertebrate and invertebrate populations.
2. Development of bacteria-free cultures of marine micro-organisms.
3. Development of mass cultures of algae.
4. Studies of the biology of organisms producing disease in marine organisms.
5. Studies of the microbial complement of the guts of selected bivalves.
- \*6. Origin, distribution and role of biologically active minor constituents of tidal waters.
7. Study of the attached bacterial flora of estuarine phytoplankton.
8. Histology and diagnosis of oyster diseases.

G. Oceanography

1. A study of the physical characteristics of the tidal waters of Virginia both estuarine and oceanic. (Estuarine work in conjunction with Chesapeake Bay Institute of Johns Hopkins holder of a V.F.L. research grant.) (Oceanic studies in conjunction with personnel of Woods Hole Oceanographic Institution.)
- \*2. Studies of hydrography of special areas, i.e. flushing studies of Hampton Roads, etc.
3. Studies of interactions between physical factors and biological populations.
4. Experimental design and data interpretation for biological oceanographers (a service function).

H. Physiology Research Department (to be established 1 July 1961).

1. Part of the effort will be in studying the physiology of marine organisms in relation to selected environmental variables.
2. Part will be in studying physiological interactions of diseased and disease-producing marine organisms.

I. Planktology

1. Energy relationships in plankton, and basic productivity of Chesapeake area.
2. Ecological and taxonomic survey of the plankton of the lower Chesapeake Bay and the York River tributary.
3. Study of basic organization of plankton communities.
4. Study of species diversity in phytoplankton.
- \*5. Study of planktonic blooms (red tides) of Virginia's tidal waters.
- \*6. Competition experiments between species in transient and steady state phases of population development.

II. Special Projects Units

A. Molluscan Physiology

1. Fecal deposition of filter-feeding marine organisms as a process in concentrating suspended radioactive wastes into bottom deposits. (With Basic Ecology-Pollution Research Section.)
2. Studies of the physiological responses of Crassostrea virginica, the Atlantic oyster to various environmental factors.

3. "Condition Index" or meat quality as related to bottom type, available food, and other variables.
4. Ecology of Myriophyllum spicatum.

B. Oyster Drill Research

1. Biology of the oyster drills, Urosalpinx cinerea and Eupleura caudata.
2. Effects of high-frequency radiation on gastropods.
3. Studies of possible drill control measures.

C. Parasitology

1. Host-specificity and zoogeography of monogenetic trematodes.
2. Studies of parasites of Antarctic vertebrates and invertebrates.
3. Host-parasite relationships between members of the family Clupeidae and their monogeneid ectoparasites.

D. Other Groups

1. Summer Scientists

a. Dr. Willis G. Hewatt

- (1) Ecology of marine invertebrates.
- (2) Studies of diseases of oysters.

b. Dr. Sewell H. Hopkins

- (1) Bucephalus parasites of bivalves.
- (2) Distribution of certain marine invertebrates.

c. Dr. Neil C. Hulings

- (1) Relationships between benthic invertebrates and the nature of the bottom in inshore and offshore waters.

d. Dr. Jacques S. Zaneveld

- (1) Algae of Virginia's tidal waters.

2. Researchers from William and Mary - using Laboratory facilities and collections (Dr. Mitchell A. Byrd); or actually attached to the Laboratory staff (Dr. R.E.L. Black).

a. Dr. Black - Studies of respiratory metabolism in marine embryos.

b. Dr. Byrd - The ecology of digenetic trematodes of marine fishes.



- 5) Source: National Science Foundation  
Title of Project: Studies of Respiratory Metabolism  
in Marine Embryos.  
Principal Investigator: Robert E. L. Black  
Grant No. G-9847  
Active Amount of support per year: \$ 3,622
- 6) Source: National Institutes of Health  
Title of Project: The Ecology of Digenetic Trematodes  
of Marine Fishes.  
Principal Investigator: Mitchell A. Byrd  
Grant No. E-3354  
Active Amount of support per year: \$ 4,542
- 7) Source: National Science Foundation  
Title of Project: Undergraduate Research Participation  
Program.  
Principal Director: Robert S. Bailey  
Grant No. G15724  
Active Amount of support per year: \$ 8,000
- 8) Source: National Science Foundation  
Title of Project: College Teacher Research  
Participation Program  
Principal Director: Robert S. Bailey  
Grant No. E1/3/42-1509  
Active Amount of support per year: \$18,810

B. Pending - recommended for support by granting agency

- 1) Source: Office of Naval Research  
Title of Project: A proposal for the study of community  
organization and energy relationships  
in plankton.  
Principal Investigator: Bernard C. Patten  
Grant No. NR 104-581  
Pending Amount of support per year: \$17,839

C. Pending - action uncertain

- 1) Source: National Institutes of Health  
Title of Project: Microbiology Research Building,  
A request for matching funds.  
Principal Investigator: William J. Hargis, Jr.  
Amount of support: \$37,625
  
- 2) Source: National Institutes of Health  
Title of Project: Host-specificity of Monogenetic  
Trematodes  
Principal Investigator: William J. Hargis, Jr.  
Amount of support per year: 1st \$11,907  
2nd \$10,079  
3rd \$ 9,025
  
- 3) Source: National Institutes of Health  
Title of Project: Attached Bacterial Flora of Estuarine  
Phytoplankton.  
Principal Investigator: George Moskovits  
Amount of support per year: 1st \$15,388  
2nd \$11,996  
3rd \$11,635
  
- 4) Source: National Institutes of Health  
Title of Project: Toxicity of Industrial Wastes to  
Marine Animals.  
Principal Investigator: Morris L. Brehmer  
Amount of support per year: 1st \$10,660  
2nd \$ 6,900

## APPENDIX IX

### FACULTY and their

#### Special Research Interests

##### Professors

William J. Hargis, Jr., Ph.D. (Head of Department and Laboratory Director). Marine ecology, parasitology, biology of Monogenea, systematics, phylogeny.

Jay D. Andrews, Ph.D. General marine ecology with special attention to population dynamics of mollusks, systematics of mollusks, epidemiology of mollusk diseases, ecology of sedentary "fouling" organisms.

##### Associate Professors

Robert E. L. Black, Ph.D. (also Associate Professor of Biology). Embryology and physiology of marine organisms.

Morris L. Brehmer, Ph.D. Pollution ecology. The productivity of marine systems as related to ecological factors.

Dexter S. Haven, M.S. Ecology of mollusks, physiology of oysters.

Edwin B. Joseph, Ph.D. General ecology, anatomy and systematics of marine fishes, embryology of fishes.

George Moskovits, Ph.D. Marine microbiology, microbial ecology.

Bernard C. Patten, Ph.D. Ecology, energetics and trophodynamics of plankton.

Willard A. Van Engel, Ph.M Ecology of crustacea, life history of the blue crab, dynamics of populations of marine animals.

John L. Wood, Ph.D. Physiology of pathogenic microorganisms. Mycology, Nutrition.

Marvin L. Wass, Ph.D. Ecology of benthic organisms

Assistant Professors

Robert S. Bailey, M.A. (Director NSF programs, Public Information Officer.) Marine biology.

William H. Massmann, M.A. Distribution and abundance of estuarine fishes, ecology of fishes.

John J. Norcross, M.S. Ecology of fishes with emphasis on behavior studies and population dynamics, biostatistics.

Summer Faculty

Willis G. Hewatt, Ph.D. (Chairman, Department of Biology and Geology, Texas Christian University). Invertebrate zoology and ecology.

Sewell H. Hopkins, Ph.D. (Department of Biology, the A & M College of Texas.) Ecology, parasitology.

Neil C. Hulings, Ph.D. (Department of Biology and Geology, Texas Christian University). Invertebrate zoology, ecology, marine geology.

Jacques S. Zanevald, D.Sc. (Head, Department of Biology, Norfolk Division, College of William and Mary.) Marine biology, marine algae.

## APPENDIX X

### CURRICULUM IN MARINE SCIENCE

The courses listed below are primarily for the graduate student who plans to specialize in Marine Science. Advanced students from other departments of the College may participate; for instance, biology majors may enroll in one of the 400 level courses, or a chemistry or physics undergraduate major (or graduate student) may conduct a marine problem in his field of specialization. Consent of the student's major department is required to take problems courses in Marine Science. Summer courses are regularly available to students from other institutions.

Most courses are given at the Marine Laboratory at Gloucester Point, but some are given on the main campus at Williamsburg. Courses numbered 401, 402, 407, and 502, or their equivalents are normally required of all Marine Science students. Demonstration of familiarity with certain basic scientific literature is also required. As a supplement to the formal courses listed below, the M.A. candidate will be given instruction in physical-chemical oceanography as available through the cooperation of the Chesapeake Bay Institute of The Johns Hopkins University. The special announcement issued by the Department of Marine Science should be consulted for further details. Application for information is usually made to the Head of the Department of Marine Science, The Virginia Fisheries Laboratory, Gloucester Point, Virginia

## Description of Courses

MS 401. Oceanography and Limnology. First semester; lectures, and field trips, eight hours; four credits. Prerequisites: Biology 101, 102; Chemistry 102; Mathematics 101, 102; Physics 102; advanced undergraduate or graduate standing. Mr. Haven and Staff.

An introduction to the physical, chemical, and biological characteristics of streams, ponds, lakes, estuaries and oceans. Particular attention will be devoted to research techniques and instrumentation. Topics will include morphometry, morphology, and hydromechanics of natural bodies of water, marine sediments, physical and chemical properties of fresh and salt water, and the characteristics and fitness of water as an environment for living things.

MS 402. General Marine Ecology. Second semester; lectures, recitation and laboratory eight hours; four credits. Mr. Andrews, Mr. Brehmer, Mr. Joseph, and Mr. Patten.

Development of the concept of the marine ecosystem as a generalized open system. The interactions of physical, chemical, and biological variables of the marine environment at the individual, population, and community levels.

MS 403. Problems in Marine Science. All semesters; hours to be arranged; credit according to performance; maximum four credits. Staffs of the Marine Science Department and cooperating National Science Departments.

Supervised projects selected to suit the needs of the advanced undergraduate students. Projects to be chosen in consultation with the head of the student's major department, the supervising professor, and the head of the Department of Marine Science. Acceptable topic outlines and terminal project reports are required.

MS 404. Biology of Selected Marine Organisms. Second semester, alternate years; lectures and laboratory eight hours; four credits. Mr. Andrews, Mr. Van Engel, and Mr. Haven.

Detailed, advanced study of special groups of marine organisms such as Mollusca, and Crustacea, etc. which are within the special interests and training of particular staff members. Emphasis on organisms of particular importance such as Balanus, Callinectes, Crassostrea.

MS 405. Systematics and Phylogeny. First Semester, alternate years; lectures and laboratory, six hours; three credits. Mr. Hargis.

General consideration of the principles and theories of systematics and phylogeny. Techniques of taxonomy, studies of the historical development of species and higher biological units.

MS 406. Marine Biology. Summer session; lectures, laboratory, and field trips, twenty hours per week for eight weeks; four credits. Staff.

A general introduction to marine science with emphasis on biological oceanography. Survey of the major groups of marine organisms and a study of their interrelations with the marine environment.

MS 407. Biometry. First semester; lectures and laboratory, four hours; three credits. Mr. Norcross and Staff.

Study of statistical techniques used in the collection and analysis of biological data. Sampling, measures of central tendency and dispersion, chi-square, interval estimates, analysis of variance and covariance, correlation, regression and experimental design.

MS 408. Ichthyology. Second semester, alternate years; lectures and laboratory and field trips, eight hours; four credits. Prerequisites: 13 credits in biology including Comparative Anatomy of Vertebrates. Mr. Joseph.

A detailed treatment of the biology of fishes which includes the topics of phylogeny and classification, functional morphology, speciation, ecology, and certain aspects of their physiology such as osmotic regulation, excretion, respiration, and reproduction.

MS 410. Marine and Freshwater Invertebrates. Summer session; lectures, laboratory, and field trips, twenty hours per week; four credits. Prerequisite: Biology 315 or Comparative Anatomy of Invertebrates. Staff.

Classification and identification, adaptation, ecology, life histories. Local marine, estuarine and freshwater forms emphasized.

MS 412. Methods in Marine Research. Summer session; lectures, laboratory, and field trips forty hours per week for six weeks; six credits. Open to teachers only, credit cannot be applied to M.A. in Marine Science. Mr. Hewatt and staff members of Virginia Fisheries Laboratory.

Designed to develop familiarity with marine organisms, life histories and ecology of marine organisms, experience with research techniques through actual approved research projects, and instruction in the collection and preparation of specimens for classroom use.

MS 501. Marine Science Seminar. All semesters; hours to be arranged; one credit each semester, maximum three credits. Staff.

The organization and presentation of scientific data. Oral discussion and written outlines and critiques of selected seminar topics required of all students in the department.

MS 502. Population Dynamics. Second semester; lectures and laboratory eight hours; four credits. Prerequisites: 13 credits in biology, and statistics or biometry. Mr. Van Engel and Staff.

Introduction to the theory of fishing and the collection of vital statistics. Estimation of recruitment, growth and mortality rates, population size, standing crop and production. Age determination, tagging and marking, morphometric and meristic data and their use.

MS 503. Advanced Problems in Marine Science. All semesters; hours to be arranged; credit according to performance, maximum four credits. Staff.

Supervised research projects selected to suit the needs of the graduate student. Projects to be chosen in consultation with student's major professor and the head of the department. Acceptable research outline and project reports are required. Training in specific areas such as marine parasitology, epidemiology and pathology of marine organisms, marine productivity, physiology of algae, experimental design, and other subjects which staff members are qualified to teach is also offered.

MS 504. Embryology and Anatomy of Marine Invertebrates. Second semester, alternate years; lectures and laboratory eight hours; four credits. Prerequisites: 13 credits in biology. Mr. Black.

The comparative embryology and adult anatomy of local representatives of all major phyla will be considered. Emphasis will be placed on the evolutionary relationships between groups. Experiments to illustrate possible mechanisms of fertilization, cleavage and organ differentiation will be performed.

MS 505. Biology of Plankton. First semester, alternate years; lectures, recitation and laboratory, eight hours; four credits. Mr. Patten.

Topics in the composition and dynamics of estuarine planktonic communities.

MS 506. Radiobiology. Second semester, alternate years; lectures and laboratory six hours; three credits. Mr. Brehmer.

A study of the principles of tracer techniques, procedures for radioassay, limitations of tracer methodology, hazards, safe handling procedures with particular emphasis on the use of isotopes in marine research.

MS 507. Marine Microbiology. First semester, alternate years; lectures and laboratories eight hours; four credits. Prerequisites: Biology 301, 302; Chemistry 301, 302. Mr. Wood.

Morphology, physiology, ecology, taxonomy, methods of isolation, cultivation and identification of aquatic microorganisms with emphasis on those from the marine environment.

MS 509. Physiology of Marine Organisms. First semester, alternate years; lecture, laboratory, and field trips eight hours; four credits. Prerequisites: Biology 101, 102; Chemistry, 301, 302. Mr. Black.

Major physiological processes will be considered. Special attention will be given to those processes in which evolutionary trends are apparent.

MS 510. Pollution Biology. Second semester, alternate years; lecture and laboratory six hours; three credits. Mr. Brehmer.

Study of the various types of pollutants, domestic and industrial wastes, soils, insecticides, herbicides and radioactive materials and their effects on the marine environment.

MS 560. Thesis. All semesters; hours to be arranged.

Original research in marine science or fisheries biology. Project to be chosen in consultation with the student's major professor and the head of the department.

APPENDIX XI

GRADUATE STUDENTS

Admitted but did not finish requirements:

William Beck  
Jesse H. Hobbs  
Reinaldo Morales-Alamo

Received M.A. Degree:

R. Winston  
B.S. William and Mary in 1940  
M.A. in 1943  
Ph.D., A & M College of Texas 1954  
Assistant Professor of Marine Science  
Oceanographic Institute, Florida State  
University, Tallahassee from 1954 to  
present.

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M. Rosalie Rogers Talbot  
A.B. Farmville State Teachers College 1943  
M.A. in 1945  
Ph.D., University of Wisconsin 1952  
Instructor, Department of Biology at  
Adelphi College in New York from 1955.

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Elizabeth A. Overcash  
B.S. State Teachers College Farmville  
in 1944  
M.A. in 1948  
Presently living with father in Farmville.

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John S. McGregor  
B.S. University of Connecticut in 1948  
M.A. in 1950  
Presently Fishery Research Biologist  
with U. S. Fish and Wildlife Service,  
La Jolla, California.

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Ernest F. Tresselt  
B.S. William and Mary  
M. A. in 1950  
Now, Hunting Creek Fisheries  
Thurmont, Maryland

---

- William H. Massmann  
B.S. University of Connecticut in 1948  
M.A. in 1952  
Now, Associate Biologist at this  
Laboratory
- 
- Henry N. McCutcheon  
B.S. University of New Hampshire in 1950  
M.A. in 1953  
Now, University of Connecticut working  
on Ph.D.
- 
- Ray T. Oglesby  
B.S. University of Richmond in 1953  
M.A. in 1955  
Now, working on Ph.D. degree at Duke  
University, School of Public Health in  
Chapel Hill, North Carolina.
- 
- Anthony L. Pacheco  
B. S. University of Massachussetts 1954  
M.A. in 1957  
Now, U. S. Fish & Wildlife Service  
Laboratory, Millville, Delaware
- 
- Sung Yen Feng  
B.S. National Taiwan University in  
Taiwan (Formosa)  
M.A. in 1957  
Now, working on Ph.D. degree at Rutgers  
University in New Jersey.
- 
- Clyde L. MacKenzie  
B.S. University of Massachusetts in 1955  
M.A. in 1958  
Now, U. S. Fish & Wildlife Service  
Laboratory, Milford, Connecticut
- 
- E. C. Ladd  
B.A. University of New Hampshire 1950  
M.A. in 1958  
Now, Staff Chemist, American Viscose  
Corp., Fredericksburg, Virginia
- 
- John W. McMahon  
B.S. University of New Brunswick,  
Canada in 1957  
M.A. in 1959  
Now, working on Ph.D. degree at the  
University of Toronto, Canada.
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## Current Graduate Students (at beginning of fall semester, 1960).

Richard B. Moore, Texas Christian University, Fort Worth, Texas  
Peter J. Eldridge, University of Massachusetts, Amherst, Mass.  
James P. Whitcomb, Alfred University, Alfred, New York  
Junius E. Warinner, Duke University in N.C. and Hampden-Sydney in Va.  
David K. Young, Michigan State University, E. Lansing, Michigan  
Eng Chow Tan, National Taiwan University, Taipei, Taiwan, China  
Peter A. Isaacson, Cornell University, Ithaca, New York  
Bruce O. Nelson, College of William and Mary in Norfolk, Virginia  
George C. Grant, University of Massachusetts, Amherst, Mass.  
Roy J. Washer, University of Richmond, Virginia

## Unclassified Students

Edward Price Roberts, Concord College, Athens, West Virginia  
Weston Eayrs, III, University of Massachusetts, Amherst, Mass.

APPENDIX XII

FLORA AND FAUNA CHECKLIST

Currently being revised. Will be mailed later.