REPORT OF
CHESAPEAKE BIOLOGICAL LABORATORY
1937

R. V. TRUITT*

THE CHESAPEAKE BIOLOGICAL LABORATORY is a research and study center founded to accelerate the acquisition of knowledge through the gathering and dissemination of facts to the end that there may be a fuller appreciation of nature. As a part of its work, instruction is offered in the biological sciences which stresses water life for which local forms are used in laboratory and field observations. Research is emphasized in which problems of conservation receive much consideration. A part of the program includes a comprehensive survey of the biota of the Solomons Island region.

The work at Solomons Island during 1937 was effectively carried on by an intensely interested group of teachers and investigators. Many additions were made to the Laboratory facilities, and, through the Maryland Conservation Department, necessary boats and other water equipment were made available for the purpose of field work.

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ORGANIZATION

The work of the Laboratory was carried on through the cooperation of the Johns Hopkins University, Western Maryland College, Carnegie Institution of Washington, Goucher College, Washington College, and the University of Maryland. Its administration was in the hands of the following committee:

Executive Committee:

ROBERT F. DUER, *Conservation Commissioner, Chairman.*
DAVID ALLEN ROBERTSON, *President, Goucher College.*
H. CLIFTON BYRD, *President, University of Maryland.*
GILBERT WILCOX MEAD, *President, Washington College.*
FRED G. HOLLOWAY, *President, Western Maryland College.*
R. V. TRUITT, *Director, (Ex-officio).*

INVESTIGATION AND INSTRUCTION

Study in the field of research has been made on problems involving applied as well as the more abstract work. These studies were carried to the Rock, *Roccus lineatus*, the Shad, *Alosa sapidissima,* and the Croaker, *Micropogom undulatus,* among the fishes; species of the Boring Sponge, *Cliona;* the Blue Crab, *Callinectes sapidus*; the Oyster, *Ostrea virginica*; the Sea Nettle, *Dactylometra quinquecirrha;* Algae, (both fresh and salt water forms); Diatoms; Hydrography of the Solomons Island Region; Stream analysis, and a Biological Survey of the Solomons Region. Formal courses were offered during the 1937 season in the following subjects: Algae, Diatoms, Invertebrates, Economic Zoology, Experimental Zoology and Ichthylogy. A limited number of candidates was allowed to register for Biological Problems and for Biological Survey, the latter a non-credit course.

The teaching and research work of the Laboratory was guided by a committee whose members were representatives of the cooperating institutions, as follows:

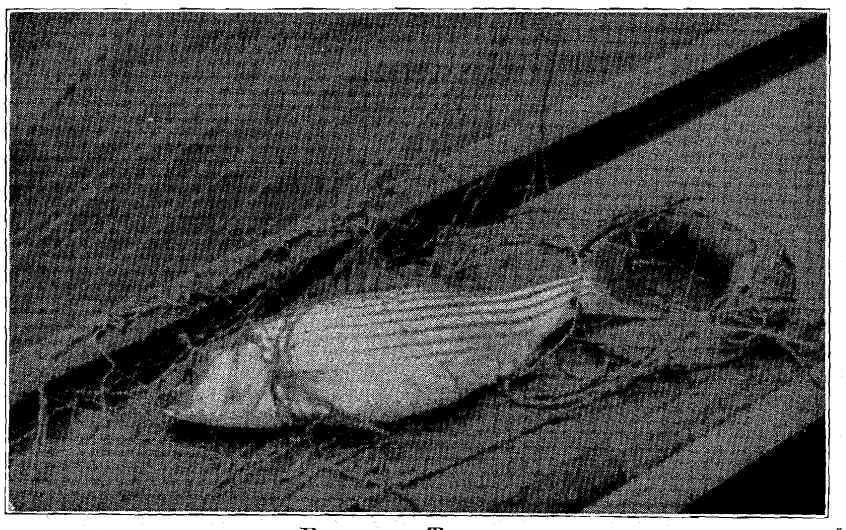
Committee on Investigation and Instruction:

R. V. TRUITT, PH.D., *University of Maryland, Chairman.*
PAUL S. CONGER, M.S., *Carnegie Institution of Washington.*
GAIRDNER B. MOMENT, PH.D., *Goucher College.*
R. P. COWLES, PH.D., *Johns Hopkins University.*
JULIAN D. CORRINGTON, PH.D., *Washington College.*
LLOYD BERTHOLF, PH.D., *Western Maryland College.*

FISH STUDIES

An intensive study of the biology of the Shad and the Rock was continued in 1937, while observations were started on the life history and movements of the Herring and the Hardhead. Extensive fish tagging in Chesapeake waters was continued, while several hundred Rock were tagged in the waters of other states.

Rock: Three thousand and five hundred Rock were tagged in Maryland, Virginia and North Carolina waters during 1937 in order to ascertain the movements of these fish. This work was a continuation of that done in 1936, when approximately fifteen hundred of these fish were released. Of the 1936 releases, six hundred and fifty-two recaptures were made by June, 1937, a total of forty-three percent of all fish released experimentally. Such high returns indicate, first: that the tags selected were suitable for this fish, secondly: that cooperation was possible on the part of the sport and commercial fishermen, and, thirdly: that the intensity of fishing for the Rock is great, although the data are not as conclusive as they seem to be since the ratio of the entire population to those tagged is not known. The greater part, ninety-seven and five-tenths per cent, of the fish upon which returns were made were taken from the Chesapeake Bay. Eighteen of the tag-



ROCK FOR TAGGING.

A LABORATORY OWNED NET CAPTURES MANY OF THE FISHES USED FOR TAGGING. THIS NET IS OF A COMMERCIAL TYPE AND IS OPERATED IN THE USUAL WAY.

ged fish, approximately two and five-tenths per cent, were taken from other bodies of water northward of the Chesapeake Bay. It is noteworthy that not a single fish tagged in the Chesapeake was taken from more southern waters.

The 1936 Rock tagging operations showed conclusively that there is considerable movement of the schools of Rock within the Chesapeake, some of which cover the entire length of the Bay. These movements seem to be governed by feeding and spawning habits. The results of tagging in Virginia waters indicate that there is a distinct school of Rock typical to the James River, a school that does not spread to the far reaches of the Chesapeake. The locally tagged Rock taken from localities out of the Chesapeake Bay were captured during February and on until late summer, and from the Delaware Bay northward to Massachusetts.

The contents of two thousand nine hundred and forty-five stomachs of different Rock taken from Maryland, Virginia and North Carolina waters have been examined and found to corroborate the observations made during 1936, with the exception, possibly, that Anchovy played a smaller part as a food article during 1937. On the other hand, the stomachs showed a marked increase in the number of Menhaden they contained. This situation may be explained by the fact that, in contrast to the previous year, Menhaden were much more abundant in the water throughout the season than were Anchovy.

Approximately thirteen thousand Rock were measured and weighed, and from every fish a sample of scales was taken. In addition, fish of different sizes have been held alive in tanks for study purposes. Data accrued from observations made on this material have been applied to problems of race determination, rate of feeding and growth, while ripening of the gonads of random samples has been analyzed in connection with spawning habits.

Statistical data of the Rock fishery have been collected from several reliable sources in the different sections of Maryland. Intensive analyses of these data have been made showing abundance, seasonal distribution, year class differences and other pertinent information contributing to the biology of the fish as well as to a better understanding of the industry itself. From the

various studies it has been established that the 1936 and 1937 high levels of production of this fish, in which the yield has increased several hundred per cent, is due primarily to the 1934 year class.

Not all of the Chesapeake spawning grounds have been established for this fish, but such areas were observed to be in the James River, in the Potomac River, in certain tributaries of Tangier Sound and in the uppermost region of the Bay.

Shad: Study of the Shad was initiated during the 1937 season. Weights, measurements, and scales were taken from this fish over a wide territory, and a limited amount of tagging work was done upon it in the Chesapeake Bay. Some tagging work was carried on with the Herring, a closely related fish. Several hundred stomachs were obtained for purposes of food analyses, a work still in progress.

Contrary to the situation in the Rock fishery, there has been a marked decline in the yield of Shad, the catches during 1936, 570,000 pounds, being the lowest in the history of the Chesapeake. Within the past three years the decline in catch has been approximately fifty per cent. While the total catch of 1936 was only one tenth of that reported for 1897. A theory that recently has become established among the fishermen in the region holds that Shad no longer concentrate in the middle and upper Chesapeake Bay, but, instead, move up the coast. Along with the development of of this theory there has come about a much larger Shad fishery in New Jersey and in New York, especially along the Hudson River. This situation leads to the long debated question as to whether or not every locality possesses its own Shad population, or whether Shad from different parts of the Atlantic Coast belong to the same school or body of fish and during some years enter certain bays and rivers for spawning purposes, while in other years they may concentrate in still other bays and rivers. Between five and six hundred Shad from Nova Scotia, Delaware Bay, and the Chesapeake Bay were studied on a structural basis and disclosed that three different bodies of fish were represented. More conclusive studies are to be made in this connection.

Preliminary tagging of Shad was done. Results indicate that the discs and pin method of tagging, such as was reported in 1936

for Rock work, may be used successfully. Fish tagged in both Virginia and Maryland waters during April, 1937 showed a definite movement toward the upper reaches of the Chesapeake as far as the Susquehanna flats. However, one of a small number of the Shad tagged in Maryland was recaptured thirty-nine days later, at Race Point, Cape Cod, Massachusetts, a distance of approximately nine hundred miles.

Following the initiation of this work, a fund of considerable proportions was made available by the Government to the U. S. Bureau of Fisheries for a long range and exhaustive study of the Shad. Future work at the Laboratory will be correlated with that of the Bureau, and the records to date will be made available to the broader study.

Other Fishes: Tagging work has been extended to include Croaker, Spot, Menhaden and a few other less important fishes. Upward of five-hundred marked individuals have been released, from some of which returns have been made. Since further efforts will be made at tagging of these fishes, the returns to date have not been analyzed.

Herring obtained from Canada and points southward to the Chesapeake were analyzed in the usual structural fashion. These fish showed regional variations, but to a less marked degree than among the Shad.

THE BLUE CRAB

Continuing the work of previous years on the biology of the Crab, *Callinectes sapidus,* marked progress was accomplished during the year. Tagging operations carried on in the sounds of North Carolina, in Delaware Bay and in the lower Chesapeake Bay were productive of records during the early part of 1937, thereby paralleling records obtained from crab tagging during 1935. Altogether, approximately eleven thousand tagged crabs have been released, about half of which were placed in the Chesapeake Bay. No further tagging is anticipated, since the records are considered complete. From the return of approximately eleven per cent of all of the tags released, a satisfactory number, it has been concluded that crabs found in a major body of water, such as Delaware Bay, Chesapeake Bay, or Pamlico Sound, have their origin and spend their entire life in it. Within a given body of water, there is a definite movement toward the saltier waters near

the ocean on the part of the female after mating, the male remaining in the waters of lesser salinity. It has been definitely shown that young crabs, following the larval stages, migrate slowly to the fresher waters in course of reaching maturity. The rate of movement, period of the year, and other pertinent facts about migration have been established.

Growth studies based upon measurements of the Blue Crab, begun in 1935, were continued during the summers of 1936 and 1937. The four dimensions compared were width, length, distance from the first anterio—lateral serration of the carapace to the lateral carapace spine, and the length of the propodite of the chela. These four linear dimensions were studied from the following viewpoints: (1) Variation, (2) Sex differences, and (3) Quantitative variations in differential growth rates. Experiments conducted in special crab floats have yielded definite information pertaining to the theoretical average number of molts undergone by this crab after it has reached a size of 30mm. in width. Particular stress has been given to the molting process, including the rate of increase in size following each molt. These studies give promise of complete harmony with the results obtained from measurements of crabs that have been grown through the several instars under controlled conditions.

During the summer of 1936, renewed effort was made to determine the number of instars and the time necessary for complete growth on the part of the crab, starting with larval forms and rearing them to maturity. Forty-nine immature crabs were kept under experimental conditions through the winter, until March, 1937, after which time there was some mortality. Some of these crabs were reared to a point where they reached one and three quarter inches in width, being kept in finger bowls in bay water under laboratory conditions. About the middle of July, these crabs were placed in specially constructed wire baskets and, for the first time, placed overboard to be fed and cared for while completing their growth. Maturity was reached by the first crab during October. From this work it has been possible to ascertain the number of moltings and the time required for reaching maturity. Also, data have been secured pertinent to growth indices. During the period when the young crabs were held under laboratory conditions, they were fed oyster, clam, crab, shrimp and other food. Vegetable matter, such as Ulva, was added to the diet with good results.

MOLLUSCS

A study of the Oyster (*Ostrea virginica*) during previous years has shown that a vast acreage of oyster bottom, that formerly was highly productive, is now barren. Several large Oyster producing areas have been shown to be productive of "seed oysters" only. More recently effort has been directed toward the problem of rehabilitation of the depleted areas, for which purpose sections have been set apart for special study. Forty thousand bushels of shells and fifty tons of slag were used in an experiment of a practical nature to determine the potentialities of five areas at the head of the Honga River. Both the slag and the shells proved to be excellent cultch material in that section. It is conservatively estimated that fifty thousand bushels of seed oysters were produced. Twenty thousand bushels of this seed were planted on public bars, with success, previous to 1937. In order to obtain accurate records on the survival and growth of this seed, areas were chosen in Pocomoke Sound, in Nanticoke River, in Patuxent River, and in the Chincoteague Bay, and approximately three hundred bushels of seed were planted in the different areas during the month of November, under conditions typical of planting operations. These planted beds are to be held inviolate for future study.

Growth studies on shellfish have been continued, special consideration being given to the hard-shelled Clam, (*Venus mercenaria L.*). Linear and shell-weight indices of size of specimens from the Gulf of St. Lawrence, Chesapeake Bay, and North Carolina were studied. It was found that regional differences in actual widths and thicknesses of corresponding lengths are not significant. The shell weights of specimens growing in the northern latitude of the Gulf of St. Lawrence are heavier than those from the warmer waters of the Chesapeake Bay and North Carolina. The results closely parallel the findings for the soft-shelled Clam (*Mya arenaria*), established at this Laboratory.

SEA NETTLE

Studies were initiated during the 1933 season on the biology of the Sea Nettle, *Dactylometra quinquecirrha,* whose life history and certain other pertinent ecological relations had not been worked out. At that time, eggs were collected, fertilized in the laboratory, and the resulting embroys reared through to attachment. These polyps were lost before winter set in and the work

was not resumed until the summer of 1935, when the present investigation was started. Eggs were fertilized under controlled conditions inAugust , 1935, and the embryos were observed to pass through a free swimming or *planula* stage before becoming attached in the culture bowls. Several of these bowls were placed overboard in specially constructed wire cages, and observations were made at regular intervals. Other bowls were cared for in the laboratory. These studies have made it possible to observe the development of the Sea Nettle from the egg through the immature stages to the resulting medusa. The experiments were continued in 1936 and carried to completion during 1937.

The results of these studies show that the Sea Nettle has an alteration of generations in the life cycle which requires one year for completion. The *polyp* form is attached to some hard object and increases in numbers by several methods of building. In late May, the polyps undergo a process of transverse fission or *strobilization,* which results in an organism having five or six saucer-like discs piled one on top of the other. Each of these discs is liberated to form an *ephyra,* the young free-swimming jelly-fish. Polyps having produced medusa do not die but, to the contrary, live and produce normal numbers of ephyra the following spring. At the close of the year 1937, polyps that have undergone strobilization two summers in succession were still under observation. These polyps appear normal in all respects, thus indicating that they may live and develop in this manner for an indefinitely long period of time. The food supplied to the polyps under study conditions, consisted of (1) animal forms present in plankton, (2) small pieces of oyster and clam, and, (3) ephyrae of their own species.

Polyps of *D. quinquecirrha,* for the first time, were found under natural conditions, being attached to oyster shells. Ephyrae were found in large numbers in the deeper waters of the creeks in the vicinity of Solomons Island. Plankton studies indicated that the ephyrae rise to the surface and become well distributed in the evening and on cloudy days. On bright days they settle to the lower water levels. Ephyrae have not been found in the waters of the Bay.

It has been shown that fertilization takes place only during early August and under water temperatures that are approxi-

mately 24°C. The gonads of both the male and the female mature during a comparatively short period. The individuals that have not reached physical maturity at this time become sexually mature and discharge their genital products as do those that have become physically mature. Reproductive cells from the physically immature individuals have been shown to be viable, since with them fertilization was effected. Results of this investigation have thrown light on the problem of speciation in which there has been considerable confusion on the part of taxonomists.

ALGAE

Continuing the work done in 1934, a study of both fresh water and marine Algae was carried on during the year. Representative collections of material were made from typical stations in the general vicinity three or more times every week. The samples were examined immediately upon delivery to the laboratory, and the Algae present were isolated for identification. It is possible to report in a preliminary way that 109 species of Algae have been determined, of which 98 were taken from fresh water. Two new species have been found in this region, while five have been reported for the first time as occurring within the United States. Only a few species collected have not been identified. The records given here are exclusive of the Diatom flora.

DIATOMS

Plankton during the summer season was exceptionally meager, consisting chiefly of organisms other than Diatoms. Although sufficient data is not at hand to give a positive clue as to the cause of this development, the most likely reason would appear to be the late, unusually cool, preceding spring with its heavy rains that kept the waters of the Patuxent River filled with more than a normal amount of suspended matter, thereby cutting down the penetration of solar radiation necessary for luxuriant Diatom growth, as well as influencing other factors, such as the acidity of the water.

Lycmophora, usually abundant, and very prolific during the previous season, was almost entirely lacking this year, and a small *Nitzschia,* generally plentiful in the latter part of July, was also absent. *Pleurosigma,* on the other hand, seemed to flourish, which is in keeping with the above-mentioned state

of the water. The difference in the flora of the 1937 summer from that of last year, and of previous seasons, brought out more strikingly than had been heretofore noted the wide degree of fluctuation and yearly variability in the Diatoms of such a river mouth or bay, in great contrast to the conditions and floras prevailing in much more stable and less varying bodies of water, as in offshore oceanic waters and in lakes. In affording widely diverging climatic contrasts, with the above consequent limnological differences making possible these observations, the past four or five summers could hardly have been selected and more suitable.

Nitszchia scalaris again flourished in and dominated most of the smaller local fresh water bodies, replacing almost entirely *Navicula socialis.* During the latter part of July the water of Great Fresh Creek, Drum Point, was "in bloom" with *Melosira crenulata,* of which occurrence a number of interesting observations were made, and a quantity of the material was collected for further tests and observations, upon which a special report is anticipated.

BORING SPONGE

The oyster, *O. virginica,* over its entire range of distribution frequently has associated with it sponge types that thoroughly riddle its shells. In the Chesapeake Bay there appears to be at least two species of oyster infesting sponge. Empty shells, as well as shells of living oysters, are attached. Locally, the condition is known as "rotten shell", due to the fact that the sponge, after becoming attached, bores in to form many branching tunnels in the calcium carbonate, a development that often is continued until the shell, completely perforated, becomes a fragile structure. The organism is definitely negative to light. It enters the lower shell, or the under side of an empty shell, and will not cross a gap, no matter how slight.

There is no evidence to indicate that the Boring Sponge is a true parasite on oysters; this in spite of the fact that there appears to be definite indication that the relationship between the two organisms frequently becomes such as to destroy entire oyster beds. The indications are that the sponge uses the oyster shell as a shelter in which to live. After gaining entrance to the shell, the tunneling processes begin and ultimately lead to large branching and coalescing caverns. From these the sponge, in communication with the surrounding water by means of surface

perforations, is at first evident only on the outer surface of the shell, but, under favorable conditions, it reaches the inner surface of the shell next to the body of the oyster. As the sponge approaches the inner face of the shell, the oyster is stimulated to make additional deposits of lime. In very active sponges the penetration continues, thus necessitating much energy expenditure on the part of the oyster to keep the inner sponge perforations closed. This results in poor oysters, with greatly thickened blunt shells. There is indication that the additional energy expenditure weakens the oysters to a point where their survival may be impossible. Inquiry into this relationship is concerned with the effect of the perforations on fluid exchange between the oyster mantle and the water outside of the shell; the possibility that wastes from the metabolism of the sponge may find their way into the mantel-cavity, thereby disturbing the oyster environment, and the effect of the abundance of the perforations in the region of the adductor muscle on the efficiency of the contractle apparatus of oysters.

Comparatively little is known about the structure and behavior of boring sponges, and work has been carried on for two seasons on the various problems involving these forms. Some progress is reported with respect to the method of boring of the shell, since it has been possible to isolate *gemmules,* have them develop and become attached under laboratory conditions. A number of specimens are being held in suitable *aquaria,* and uninfested oysters and clean oyster shells have been collected and exposed, under natural conditions, for seasonal studies in an effort to determine the time of sexual maturity, the period required for the development of the larvae and the season or seasons in which the setting or sponge fall takes place.

Many samples of boring sponges have been gathered from the Chesapeake Bay, and representative collections have been taken along the Atlantic Coast. Analyses of several samples indicate that there are marked differences in the spiculation, in the nature of the canals, and in the general behavior which do not permit the use of the commonly applied scientific name, *Clionia celata,* for all of the boring sponges. This part of the sponge studies is nearing completion, and a report on same is to be published summarizing the kinds of Boring Sponges and their distribution along the Atlantic Coast.

HYDROGRAPHICAL STUDIES

These studies, initiated in June, 1936, have been continued in an effort to present a picture of the conditions operating in the waters of the Bay that influence its productivity. Seasonal variations in numbers of plankton organisms, which serve directly or indirectly as food for all the large aquatic organisms, have been studied, as well as the conditions that seem to produce the local, and seasonal, changes in the density of the populations. The facilities for this program of study have been much improved. The completion of a suitable instrument house has made it possible to obtain continous and automatic temperature and tidal records.

The general hydrographic information accrued from these studies permits of a delimitation of the density strata in the Patuxent River and nearby waters of the Bay. Surface variations in salinity throughout the year are marked, ranging from 8.78-o/oo on May 7, 1937 to 17.95o/oo on November 7, 1937. Greater stability in respect to density characterizes the heavier bottom strata. In the direction of the headwaters of the river the salinity of both layers decreases rapidly. They retain their identity, however, and only locally do they exhibit evidence of much mixing, excepting, of course, during the spring and fall overturning. The fall turnover occurs much earlier in the river waters, being progressively later in the direction of the Bay. Another, and perhaps equally significant, factor with respect to its biological implications is the marked variations in turbidity during the different seasons and throughout the area of the investigation.

It has been shown that, during summer, an extensive bottom stratum of water that is very low in oxygen content extends over a wide section of the Bay. The depths at which the low oxygen content is obtained vary significantly within short intervals of time and distance. At eight to ten meter depth, values ranging from 2.5 c.c. to 3.5 c.c. per liter frequently are found, whereas below a depth of 12 meters, the oxygen concentration drops under 1 c.c. per liter. Wide areas have been sampled in which no measurable quantity of oxygen could be detected. This rather unique oxygen stratification is the subject of special study since its influence in the survival, density and migration of local fish populations is considered of paramount importance.

The spring plankton maximum for 1937 occurred during April and early May. The nitrate maxima precede those of the plankton, and a decline was found to begin before the plankton peak was reached. Difficulties were experienced in making quantitative estimates of the microscopic life in the water. For this reason, experiments were conducted during 1937, and are being continued in an effort to arrive at a satisfactory basis for expressing the quantity of plankton organisms present.

Results of bacterial analyses of the surface and bottom waters have shown that a correlation exists between concentration of oxygen and abundance of anaerobic bacteria, an inverse relationship being found to occur over the area studied during the year. These forms play an important role in affecting the amounts of nutrient salts available for the aquatic plants.

It is well known that the distribution and abundance of fishes are dependent on conditions of the water within narrow limits. Marked variations in the aquatic environment have been found to exist in areas of close proximity. This fact constitutes convincing evidence of the part these studies should occupy in any concerted attack on the many brackish water problems of conservation

STREAM SURVEY

Studies initiated during the 1936 season on the chemical, physical, and biological aspects of certain fresh water streams in Maryland, that is Gunpowder Falls, Little Falls, Western Run, and the Patapsco River, were pursued during 1937. The immediate purpose of this work was to ascertain the fitness of the streams for fish life. The results obtained indicate that sections of Gunpowder Falls and Little Falls are polluted to a degree that is injurious to fish life in general, thus stocking in these sections was advised against until certain corrections are made. The study of Western Run did not disclose pollution, but did indicate that, because of food shortage and high temperatures during the summer months, this drainage system is not well suited to trout life. The Patapsco system was shown to be polluted by industry.

A comprehensive study has been initiated in the Patapsco River, including both harbor and lower tributary sections, such as Curtis Bay. This study will be of a hydrographic nature. The types

and quantity of pollutants will be established along with the effects of the pollutants upon the plant and animal life common to the region.

BIOLOGICAL SURVEY

The gathering and identification of the biological forms of the Chesapeake Bay were continued during the current year. In every branch of work, many species unrecorded in the Solomons Island region were found. Among the animals, the snail fauna received special attention.

STATE COMMISSIONS

The personnel of the Laboratory continued its cooperation with the State Planning Commission in making studies of the organization and policies of conservation in Maryland. Information available on the subject of natural resources of the state was placed at the disposal of the Commission, and one member of the staff served as chairman of its committee on conservation. Further study of this committee will be made of both fresh and salt water fishes, of game, and of the administration and policies concerned with conservation and rehabilitation of Maryland's natural resources. Contributions of the Laboratory have been placed at the disposal of the Maryland Development Bureau, an agency concerned with the development of the State's potentialities. One member of the staff is serving on this bureau.

EDUCATIONAL WORK

Opportunity was offered at the Laboratory, during the summer of 1937, for a limited number of selected, interested students to take work of advanced standing in the field of biology, in which marine life was stressed. Class work was given in Invertebrates, Algae, Economic Zoology, Diatoms, Ichthyology, Experimental Zoology, Biological Problems and Biological Survey. In order to assure a better quality of instruction, and at the same time give those in charge of teaching at least one-half of their time for research, the classes were kept small, ranging from three to eight students per class, according to subject. Three semester hours credit was given for each of the various courses, with the exception of Invertebrates for which six credit hours was issued. Graduate students were permitted to take, in addition to the normal load of six credit hours, added work in the nature of research for

which additional time was required beyond the usual six weeks period of summer school. The combined work of such students was not permitted to exceed nine semester hours each. The course work proper extended from June 23 to August 4. All work offered was either of graduate or of advanced under-graduate level. Students who registered for work received credit through the cooperating institution of their choice, whose permission was necessary. Due to the limited number of students accepted for the work, only a small part of the large number of applicants to the summer school was accepted. All classes were filled to capacity.

Formal class work was pursued five days per week, while one day every week was given over to field exploration in which the entire personnel and student group collected desired forms and

INFORMAL STUDENT GROUP.

made observations on living material in the general region. These trips were made to sections where there was known to be an abundance of animal and plant forms; wild fowl breeding grounds, diamondback terrapin habitats, muskrat marshes, oyster and crab producing regions and other rich areas were included in the itineraries. These trips were made by boat, and the observations were concerned primarily with forms related to water. In addition to offering an opportunity to study organisms in their natural setting, these field trips made it possible

for students to observe the methods employed in several local industries founded on natural resources.

Following an established policy, the Laboratory offered during the summer two lectures of general interest, to which the public was invited. These lectures were given by highly competent men, Dr. S. H. DeVault, of the University of Maryland, and Dr. Paul Bartsch, of the United States National Museum, their respective subjects being, "The First Family of Solomons, the Patuxents", and "The Birds of the Chesapeake Region". Both lectures were abundantly illustrated by pictures, while a big display of Indian artcrafts was used to illustrate the methods and findings of one of the lecturers. These lectures again were well received by the public, the attendance taxing the capacity of the auditorium in which they were held.

Members of the staff available during the year responded freely to invitations to address scientific organizations, school, college and public meetings on topics relating to their work, to conservation and to wild life in general. Specialists associated with the Laboratory have been called into consultation by conservation authorities in several states, and they have served on important committees, both state and national. Moving picture films of the work done at the Laboratory on the biology of certain local forms have been exceedingly popular with the public. Many letters asking for information concerning living forms, water conditions and problems of interest to the public in general have been received and given attention. Work of this nature has grown constantly.

PUBLICATIONS

Based upon work at the Laboratory, several publications were issued during the year. These papers were distributed to some five hundred institutions and workers in the field of marine zoology. In exchange, many publications have been contributed to the library collection which, in addition, has been greatly augmented by purchases of new reference works. Publications issued were as follows:

Preliminary Report on Respiratory Studies of *Littorina irrorata*. Nature, Vol. 137, No. 3453, 1936. Newcombe, Cuurtis L; Miller, Charles E., and Chappel, Donald.

Annual Report for 1936. Chesapeake Biological Laboratory. State Press, December, 1936. Truitt, R. V.

Variations in Growth Indices of *Mya arenaria* on the Atlantic Coast of North America. Ecology, July, 1936. Newcombe, Curtis L. and Kessler, Herman.

Striped Bass Investigations in the Chesapeake Bay. Transactions, American Fisheries Society, Volume 66, 1937. Truitt, R. V. and Vladykov, V. D.

Growth Indices of *Littorina irrorata.* Part I, Length, Width, Peristome-Width, and Volume. Biologia Generalis, Vol. XIII, part 2, 1937. Phillips, Norman E. and Newcombe, Curtis L.

Growth Indices of *Littorina irrorata.* Part II, Length, Shell Weight, and Weight of Body Parts. Biologia Generalis, Vol XIII, part 2, 1937. Newcombe, Curtis L., and Gould, Sophia A.

Variations of *Dactylometra quinquecirrha.* Science, Vol. 86, No. 2236, November 5, 1937. Littleford, R. A. and Truitt, R. V.

Validity of Concentric Rings of *Mya arenaria* L. for determining Age. Nature, Vol. 137, No. 3457, 1936. Newcombe, Curtis L.

Baltimore and the Oyster Industry. Watkins Press, Baltimore, November, 1937. Truitt, R. V.

PHYSICAL DEVELOPMENT

Added buildings and physical equipment were obtained during the past year. An instrument house, seven by five feet and nine feet high was constructed at a point of advantage on the new pier, approximately seven hundred feet from the shore line. In this building are housed certain new equipment, parts of which are built in, such as automatic tidal and temperature recording devices, barometer and other hydrographic instruments. Approximately three hundred feet from the shore a strongly constructed pavilion was built to serve purposes of both work and pleasure. Several volumes have been added to the library collection in an effort to build it to a high degree of usefulness. Apparatus and equipment within the Laboratory itself have been added to meet the new demands that have arisen in connection with the several lines of investigation. In addition to new tanks, basic equipment for work in chemistry, a commercial gill net and other forms of supplies have been secured. A new heating plant for the entire Laboratory is being installed.

Plans for the construction of a new two-story and basement masonary building have been developed and are ready to be submitted for final approval. The new building will be used for dormitory purposes, thus serving a long felt need. The architectural design, colonial, will conform to the main laboratory building.. Its capacity will be approximately thirty-five persons. A dining-room and kitchen are to be provided in it.

ACKNOWLEDGMENTS

Institutions that have given cooperative support to the Laboratory in the past contribuuted to its management and progress during 1937. This interest has been productive of a continued fine spirit among those who work at Solomons Island. Through the support of Johns Hopkins University, Dr. M. C. Old, of Ursinus College, continued research on the Boring Sponge, and offered an advanced course in Economic Zoology, while Dr. R. P. Cowles of that institution served one of the Laboratory's committees. Dr. R. B. Roulston and Dr. S. O. Mast, of that institution, offered helpful suggestions for the development of the Laboratory's work. Dr. J. D. Corrington represented Washington College on a committee assignment but, due to late developing complications, was unable to offer the formal course in advanced Invertebrates, for which his institution was able to secure the services of Dr. Coleen Fowler, Associate Professor of Zoology in Greensboro College, North Carolina. Western Maryland College continued the research and teaching work in Algae, supporting the work of Dr. H. C. Bold of Vanderbilt University.

The Carnegie Institution of Washington, through the interest of its president, Dr. John C. Merriman, again supported investigation and instruction in Diatom work with Mr. Paul S. Conger, of that institution, and Custodian of Diatoms at the Smithsonian Institution, in charge. Dr. Vadim D. Vladykov, whose services were borrowed by the Laboratory in 1936 from the Biological Board of Canada, continued his life history studies of certain Chesapeake fishes, being assisted by Mr. David H. Wallace, a graduate of Washington College. Associated with Dr. Vladykov during the year was Mr. Edgar Hollis, a graduate of Western Maryland College.

Blue Crab studies, concerned primarily with migration and with the immature stages, were continued by Dr. R. V. Truitt, of the University of Maryland, and Mr. Roy L. Robertson, a graduate of Western Maryland College. Mr. Richard Armstrong, Virginia Commissioner of Fisheries, made available for this work samples of crabs when requested. In addition, the Virginia Commission tagged outright a number of Crabs and Rock to be released for the Laboratory in Virginia waters. The Delaware Game and Fish Commission made a liberal contribution of Shad for

purposes of racial studies of this fish along the coast. The North Carolina commercial fisherman, fish dealers and sportsmen made decided contributions in effort, in time, and in fish, to the progress of Chesapeake research.

Continued studies of problems in hydrography were made by Dr. C. L. Newcombe of the University of Maryland, assisted by Mr. B. B. Shepherd of North Carolina University. This work was sponsored by the Maryland Agricultural Experiment Station, through the interest of its director, Dr. H. J. Patterson, while the United States Coast and Geodetic Survey cooperated in having installed a meter for current measurement, and barometric and thermometric recording devices. The features of this work involving chemical studies were handled by Messrs. W. H. Baldwin, Joseph Lann, and Gordon Dittmar, the services of the first named being made possible through the office of Mr. J. M. Lemon of the College Park Technological Laboratory of the United States Bureau of Fisheries, while Messrs. Lann and Dittmar were brought to the work through the interest of Dr. L. B. Broughton, Head, Department of Chemistry, University of Maryland. Dr. L. H. James, Head, Department of Bacteriology, University of Maryland, directed the Bacteriological studies and provided basic equipment for this aspect of the work. Through Dr. James' office, Miss Katherine Cunningham was detailed to the work, an essential part of which was the handling of the bacteria counts of all water samples. Professor Charles Eichlin, of the University of Maryland, cooperated in the hydrographic work in his physics laboratory and offered much help in connection with photo-electric experiments. Mr. L. A. Kanatzar, University of Illinois, analyzed, on a qualitative basis, as far as possible, the hydrographic water samples for protozoa.

Mr. Robert Littleford, University of Maryland, continued Sea Nettle studies during the year with good results, and, in addition, assisted in certain hydrographic studies involving precision of methods in quantitive plankton analyses. Mr. Fred Seiling, a graduate student in the University of Maryland, devoted a full year to stream survey work in Baltimore County, Maryland. Miss Ellen Gray, instructor in the Reisterstown High School, concluded during the year two seasons observations on growth rates of the Blue Crab. Miss Frances Allen,

Radford Teachers College, Virginia, devoted the summer to the collecting and studying of the local snail fauna.

The Maryland Conservation Department, continuing its policy of the past, made available for field work, laboratory and class routine, appropriate boats, well manned. The Department, in full cooperation, very efficiently handled the fiscal affairs of the Laboratory, negotiated all purchases, and offered considerable help of an intangible nature with the program at Solomons Island.