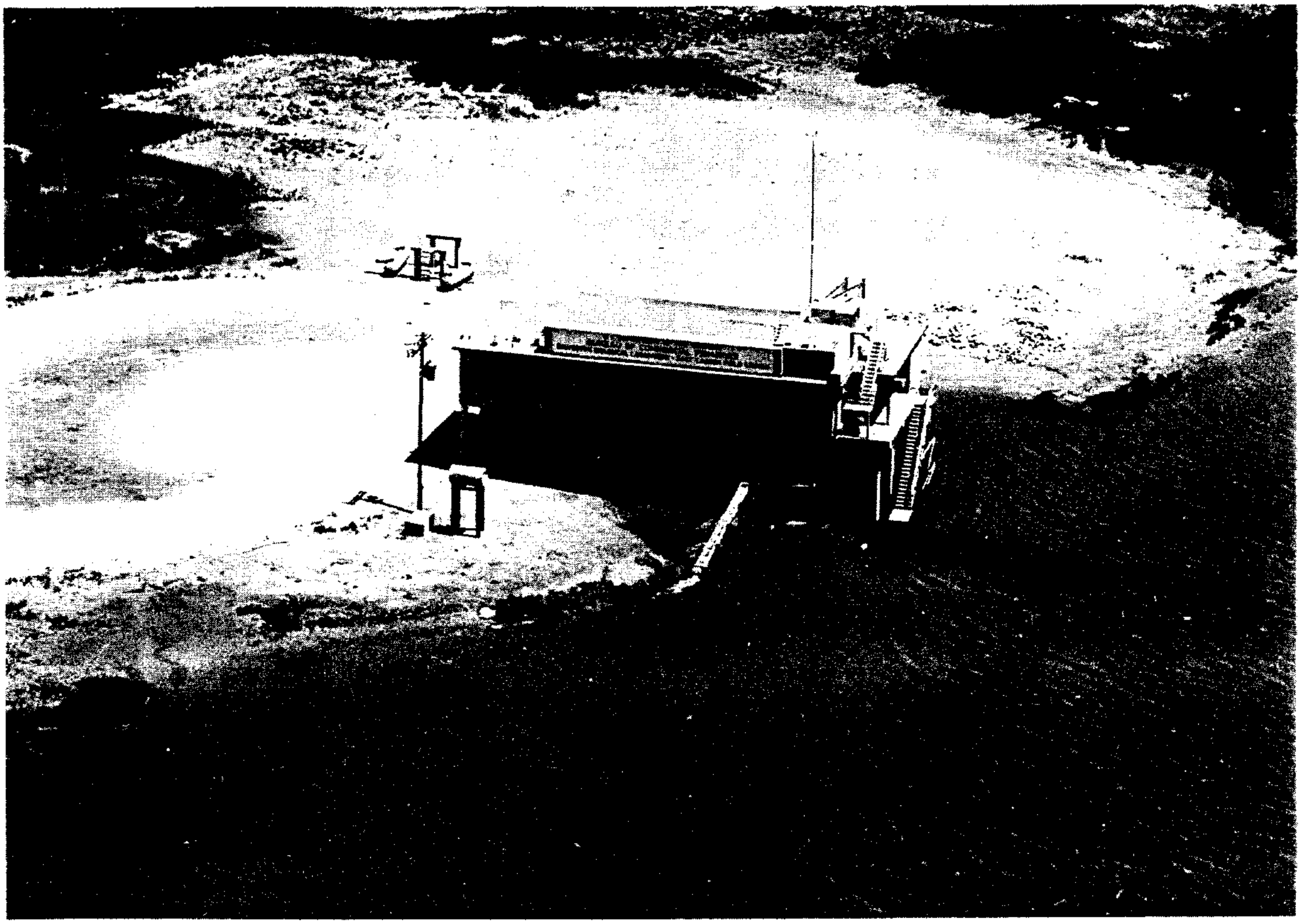
FISHERY RESEARCH
BIOLOGICAL LABORATORY, GALVESTON

FISCAL YEAR 1962



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES

CIRCULAR 161

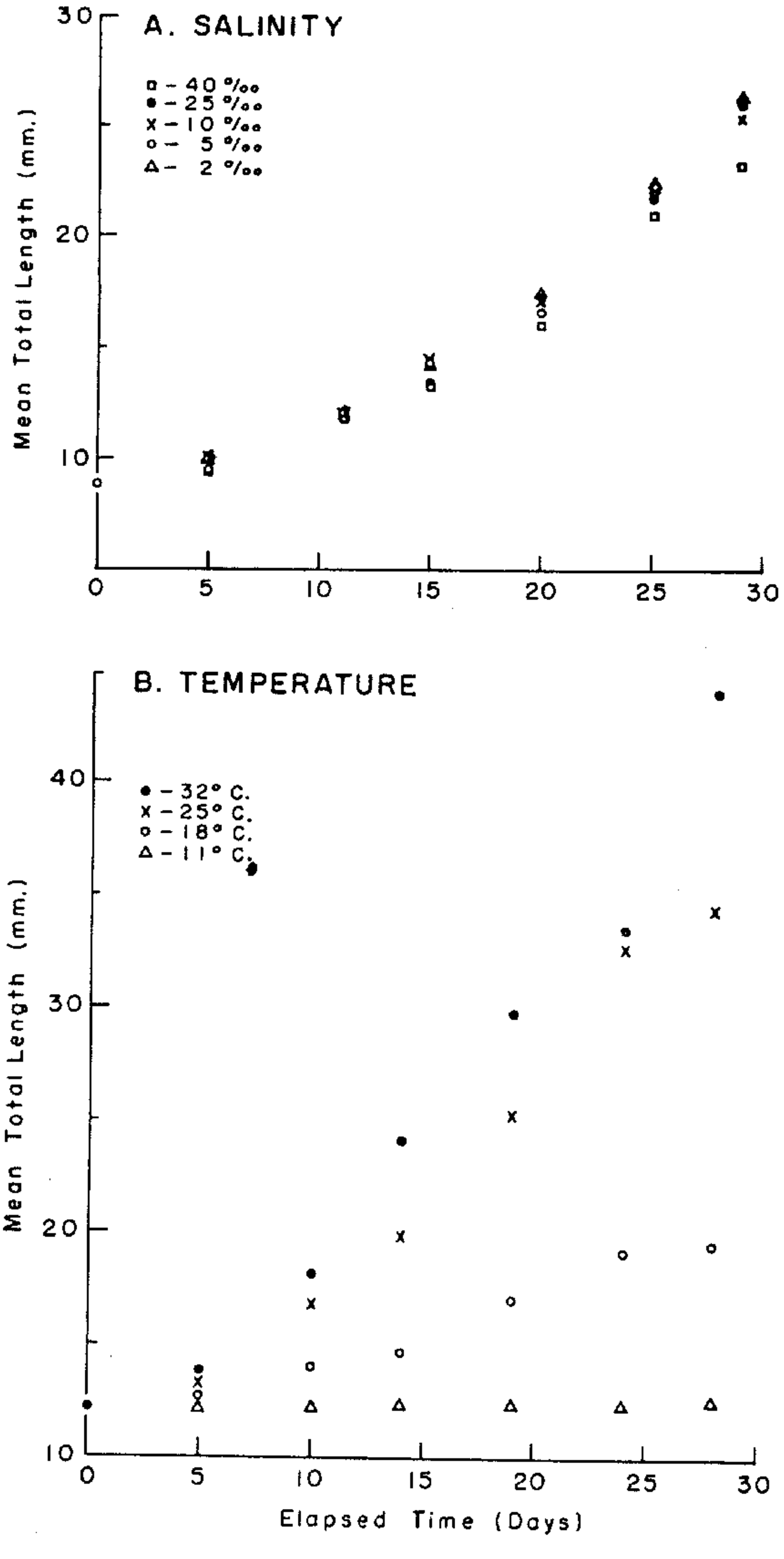
Growth and Metabolism

During the past year, several experiments with young shrimp were conducted using growth as a sensitive indicator of the suitability of controlled environments. The initial series tested the effects of salinity alone on growth of postlarval shrimp, both "grooved" and white. As indicated in the accompanying figure (next page), variation in salinity over the wide range of 2‰ to 40‰ had little effect on the growth rate of postlarvae held for approximately 30 days at 25° C. (77° F.). These experiments indicated that under the relatively restricted conditions of temperature and feeding imposed, salinity *per se* was not an important limiting factor in the growth of postlarval penaeids.

In March of this year, a large-scale growth experiment was initiated to test the effects of salinity at various temperatures. Five levels of salinity (2‰, 5‰, 15‰, 25‰, and 35‰) were used at each of four temperatures, 11°, 18°, 25°, and 32° C. (52°, 65°, 77°, and 90° F., respectively). Differences in growth associated with temperature were dramatically greater than those related to salinity. (See figures next page.) Essentially, no growth occurred at 11° C., while animals held at 32° C. increased slightly more than 1.0 mm. per day during the 28 days of the experiment, and those at 25° C. increased approximately 0.8 mm. per day during the same period.

Growth of individuals in experiments conducted this year has exceeded the growth observed at the same temperature and salinity last year. (Compare A and B in figure next page.) At 25° C. and 25‰ in 1963, the largest postlarva quadrupled its length and increased its weight hundredfold (12.1 mm. and 6.7 mg. to 46.5 mm. and 681.1 mg.) in 28 days. In 1961, at the same temperature and salinity, the greatest growth of an individual was only threefold in terms of length and sixty-fold in terms of weight (10.4 mm. and 4.5 mg. to 34.0 mm. and 262.8 mg.) over a 29-day period. Much of this increased growth must be attributed to the development of a better means of providing food. Although all experimental animals had been fed live brine shrimp nauplii as the exclusive diet, recently improved rearing techniques have made larger amounts of such food immediately available.

The variation in amount of food required by experimental animals was markedly related to temperature. Animals at 32° C. were still without food at times, even though they were given more than 100 times the amount of food provided those animals at 11° C. When the experiment was terminated, postlarvae at 32° C. were 60 times heavier than those at 11° C. Undoubtedly, most of the food was required for growth itself, but some food must also have been used to supply energy



Comparison of salinity and temperature effects on growth of small grooved shrimp.

for the increased activity observable at the higher temperature. These data serve to reemphasize the importance of an adequate food supply for rapidly growing young, and may indicate the ultimate value of the estuary as a place which can provide the vast amounts of food required for postlarval shrimp to develop quickly into juveniles and subadults before returning to the open sea.

It is of some interest that almost all animals survived for 28 days at 11° C. at salinity levels of 15‰ or above. At the two lowest levels, however, all animals died before completion of the experiment. At the intermediate temperatures of 18° and 25° C., almost 100 percent survival occurred at all salinity levels with the exception of those at 2‰. At 32° C., however, survival rate was considerably decreased at all levels except that of 35‰. At this high temperature, survival was apparently decreased both by stresses during acclimation and probably by cannibalism. These experiments further indicate the wide salinity tolerances exhibited by postlarvae and emphasize the important roles played by food supply and temperature, both in the growth and behavior of young shrimp.

The growth of individual postlarvae rather than of groups has also been studied during the past year, both with respect to the frequency of molting and to actual size attained. A group of 40 juvenile white shrimp, previously held in the laboratory for studies on molting frequency, was transferred to the recirculating estuarine-water system during the winter. Each individual was measured biweekly (total length from tip of rostrum to end of tail) and held in a $2\frac{1}{2}$-gal. aquarium with water supplied by the system. All experimental animals were fed ground shrimp and fish. During the 3 mo. of the experiment, little or no growth was observed for the 20 animals surviving the initial transfer. Temperatures during the period ranged from 11° to 18° C. In the spring of this year, the experiment was repeated using postlarval grooved shrimp. Temperatures at this time were 25° C. or above. During the first 30 days of the experiment, each of 22 surviving animals showed some growth, which ranged from 3.5 to 9.5 mm. Although growth rate was below that found for isolated postlarvae fed brine shrimp in the laboratory, these experiments further illustrate the effect of temperature upon the growth of postlarvae and juvenile shrimp.

Other growth experiments included a series to test the influence of the number of postlarvae per container upon growth rate. Standard 20-gal. aquaria were stocked with 25, 50, 100, or 200 postlarvae. The 30-day experiment indicated that best growth occurred with 50 animals, while growth rate decreased with either fewer or more animals. Food (brine shrimp nauplii) was provided in proportion to the number and size of animals. An increase in the number of animals above 50 per aquarium probably caused reduced growth because of crowding, whereas shrimp in aquaria of only 25 animals may have had to exert more effort to obtain food because of the relatively low density of the food supply.

Also undertaken during the year were other types of studies, the results of which will be given in later reports. This work included preliminary analyses of the pigments in the two common species of shrimp, further experiments with anesthetics for use in metabolism studies of shrimp, and preliminary studies of the types of amino acids present in the two species of shrimp.

Zoula P. Zein-Eldin, Project Leader