It is not practical to attempt either distribution studies or predator-prey studies on this population because the low percentage of deformed fish (the index that would have been used) requires an overwhelming expenditure of energy to obtain an adequate sample.

The estimated age composition of fish probably does not reflect the correct proportions for the lake but only for the fish caught in the traps. Fish less than four years of age do not intermingle to a very large extent with older fish and tend to concentrate in shallow regions where other types of fishing gear must replace the trap. Consequently, the results being from different types of gear cannot be added.

Results from mating experiments were successful in demonstrating that if the deformities are inherited, they are not inherited in accord with a simple pattern. With what is now known, it is not possible to say whether or not the deformities are of a genetic origin. However, they seem not to be caused by either temperature fluctuation, low dissolved oxygen, or some chemical in the water of Two Ocean Lake. Further mating experiments in which Two Ocean Lake chub are compared with chub from other waters should throw some useful light on the problem.

Irvin E. Lawrence, Jr., University of Kansas, assisted on this project.

Supported by National Science Foundation.

Metabolic Differences Associated with Altitude

Garth Kennington
Lawrence College
Project Number 79

This project is concerned with certain physiological aspects of altitude, particularly as they act to limit the range of or isolate populations and species of animals. It has now run through the summers of 1955, 1956 and 1957. The results of the studies of the first two summers have been summarized in a paper which is being published in the October 1957 issue of Physiological Zoology. The work of this report dealt primarily with the effect of differences in altitude on the rate of oxygen uptake in two species of arthropods and has been summarized in previous reports.

In the summer of 1957 an attempt was made to widen the scope of the experiments in line with the original aim of the study. Using Tribolium confusum as a subject, cultures were established in three experimental situations designed to make a preliminary survey of the effect, if any, altitude may have on the lengths of the larval and pupal stages of this flour beetle. The cultures were started with day old larvae and maintained in flour medium according to the following schedule:

1. Biological Station incubator — Replicates
   Temperature: controlled at 28° C.
   Relative humidity: controlled at 78%
   Elevation: 6750 feet
   larvae 40
   pupae 35

2. Biological Station Grounds
   (shaded, ventilated containers)
   Temperature: normal outdoor, shaded — larvae 36
   Relative humidity: normal outdoor — pupae 30
   Elevation: 6750 feet

3. Two Ocean Mountain
   (shaded, ventilated containers)
   Temperature: normal outdoor, shaded — larvae 36
   Relative humidity: normal outdoor — pupae 28
   Elevation: 10,500 feet

The results have been tabulated below. A fourth category has been added to the table to provide a stronger basis for comparison. This group consists of a series of similar experiments made some years previously in Chicago. It should also be noted here that weekly means of temperature and relative humidity have not been computed for the outdoor situations since in no case were larval or pupal stages completed in the time available.

Location of Experiment	Altitude (feet)	Mean Temp. (°C.)	Mean Relative Humidity,%	Length of Larval Stage(hr.) Mean=S.D.	Length of Pupal Stage(hr.) Mean=S.D.
Moran, Station incubator	6750	28.2	76	524.2=37	186.8=5.4
Moran, Station grounds	6750	15.2		None of the stages in these two groups were complete after 768 hours	
Two Ocean Mountain	10,500	12.5	51		
U. of Chicago lab. incubator	500	29.1	78.1	399.3=46	143.8=1.49

As might be expected, development was slowed considerably in the lower temperatures. In this connection two observations are worthy of note. The pupae involved appeared to remain healthy in almost all cases (2 dead of 65) in contrast to the larvae which did not grow substantially beyond about 1 millimeter in length (about twice that at which they were introduced into the cultures) and toward the end of the 32 day observation period they gradually disappeared and could no longer be detected in the flour.

The primary interest of the experiment centers in the comparative lengths of larval and pupal periods in the controlled situations at Chicago and Moran altitudes. These preliminary results indicate that there may be a lengthening of the larval and pupal periods associated with factors other than temperature.

These tests suggest that it may be useful to explore the life cycles of the invertebrates more fully with respect to altitude. Not only may some light be thrown on the question of whether altitude can act in a limiting fashion but the markedly different response of larvae and pupae suggests that a start can be made toward explaining the mechanisms involved.

Supported by New York Zoological Society.

Environment in Relation to Numbers, Kinds, and Morphology of Soil and Root Inhabiting Nematodes

W. F. Mai
Cornell University
Project Number 91

Soil and root inhabiting nematodes are becoming increasingly more important in our agricultural economy. At present little is known concerning their host ranges or other ecological relationships. The area surrounding the Jackson Hole Biological Laboratory is an excellent environment for making certain studies in this general field, especially those involving marked altitude and moisture changes within a relatively short distance. It is hoped that results obtained from these studies will supplement results obtained from laboratory, greenhouse, and field experiments being conducted on this same general subject at Cornell University.

During the past summer 66 soil samples and 66 root samples were collected in the Jackson Hole area. The sampling sites varied from 6,200 to 10,500 feet in elevation. With respect to degree of moisture these sites varied from marshy locations near the Snake River to areas receiving only sufficient moisture to support sage brush. Root samples were taken from 26 different kinds of plants, varying in type from large trees to small herbaceous annuals.

Nematodes were separated from roots by an incubation procedure and from soil by means of the Baerman funnel technique. After examining the recovered nematodes with a stereoscopic microscope they were killed by gentle heat and preserved in five per cent formalin.

During the winter months representative individuals will be mounted on slides and identified to species, using an oil immersion lens. An attempt will be made to correlate nematode species with location and with plant species. Individuals apparently belonging