Technical Papers

A Thermophobic Insect[1]

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Recent interest in the physiology of organisms known to be tolerant to relatively low temperatures (*1*) prompts me to report observations made in 1948 concerning the life history of the stonefly, *Nemoura columbiana* Claassen (order Plecoptera).

Stoneflies were among the first adult insects observed to be active in the vicinity of Anchorage, Alaska, during the spring of 1948. Specimens of *Nemoura cintipes* Banks and *N. columbiana* Claassen (identified by W. E. Ricker) were taken as early as April 9. They continued to emerge from the smaller streams as rapidly as the ice covering the streams broke up.

On April 19 a stream on a mountainside 17 miles northeast of Anchorage was examined. It was entirely frozen over for one-half mile below the point where the stonefly observations were made. Higher up, the stream flowed down a precipitous slope through a channel buried deep beneath a series of ice cascades. Along the lower part of the stream, water could frequently be heard flowing beneath the ice, and at such places holes were cut so rocks could be withdrawn and examined for black fly larvae.

A short distance below the ice cascades a hole was cut through 1 ft of snow and 2 in. of ice. This hole was found to open into an ice cavern that had been eroded in the ice immediately over a riffle in the stream. On the ceiling of the ice-enclosed cell were 2 mating pairs and 19 individual specimens of *N. columbiana* Claassen. Three individuals were seen to fly out of the hole and land near by on the snow, where they crawled actively about.

The temperature of the water in the stream and of the air inside the cell was 32° F. The air temperature outside was 30° F. An overcast sky minimized any chance that the dark-bodied insects might be warmed to some extent by solar radiation. These insects appeared to be conducting themselves normally and enjoying full use of their body functions at a temperature of 32° F. The ice covering this part of the stream did not break up until about 10 days later, and had the insects been left undisturbed there is good reason to believe that they could have deposited eggs and died without escaping into the open air.

Weekly temperature records were kept for this stream from April 19 through October 26. The highest temperature recorded was 44° F, and the average of all records was 38.03° F. From these stream temperature records, and the observations concerning the adults, it would appear that these insects have a remarkable capacity for growth and function at temperatures that are continuously near the level at which development of most insects ceases.

In view of the well-known tendency of poikilothermic animals to prolong their period of development when subjected to temperatures below optimum, it might be expected that *N. columbiana* and related species of *Nemoura* would require more than one season to complete their development. Available evidence (*2, 3*), however, indicates that the species of *Nemoura* have one generation a year. If this is true, these insects should prove worth-while subjects for study by workers interested in the physiology of organisms living under conditions of quite low temperature.

[1] These observations were made incidentally during the course of studies concerned with the biology of Alaskan black flies. These, and associated investigations, were conducted by the Bureau of Entomology and Plant Quarantine, USDA, under a transfer of funds from the National Military Establishment.

References

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The Effect of Reinforcement History on Extinction after Reconditioning

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This paper deals with an experiment to determine whether extinction to operant (preconditioning) level is permanently effective in eliminating differences in response strength among groups given varying amounts of original conditioning. Resistance to extinction after a constant amount of reconditioning was used to test the effectiveness of the preceding "complete" extinction. Nearly all reported studies of reconditioning have clearly involved only partial interpolated extinctions, as in periodic or aperiodic reinforcement (*1–4*). Two reported experiments in which a criterion of complete extinction was met (*5, 6*) were concerned with avoidance conditioning, and are, thus, not directly pertinent to the present study. Nevertheless, in one of these (*6*), the data for

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