ESPECIALLY FOR FIELD COLLECTORS

(Under the supervision of FRED T. THORNE, 1360 Merritt Dr., El Cajon, Calif., U.S.A.)

NOTE ON RATES OF DRYING AND RELAXATION OF SPECIMENS

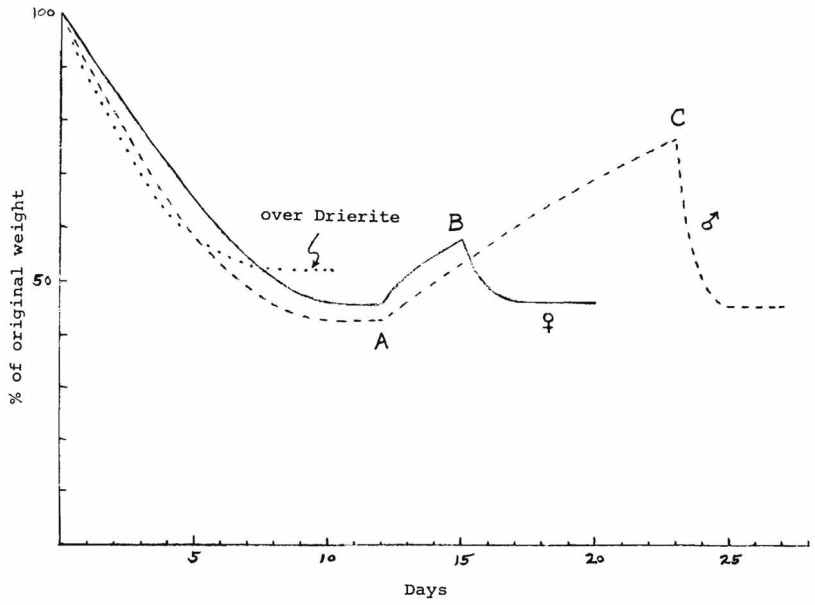
by JOHN M. KOLYER

Having long been curious as to how long butterflies take to air-dry to constant weight, how much moisture is lost, how fast it is regained during relaxation, etc., I collected the following data.

On Aug. 16, 1962, at Bristol, R. I., a mating pair of *Danaus plexippus* was captured and killed with carbon tetrachloride fumes. The fresh weights were 0.416 gram (male) and 0.492 gram (female). The specimens were stored over para-dichlorobenzene crystals (to repel pests) in a wooden box with loose-fitting cover. Each day they were weighed to three decimal places, and the results, as percent of original weight, were plotted (graph, p.179).

During the drying period the relative humidity (at Seekonk, Mass.) varied from about 30 to 90%, but since this is, presumably, a case of drying in which diffusion of water through the body of the insect is rate-controlling, the ambient humidity would be expected to influence the equilibrium moisture content but not greatly affect the rate of drying. By about ten days both specimens had reached constant weight (equilibrium moisture content). The male had lost 57% of its original weight, and the female had lost 54%.

At point A in the figure both specimens were placed over water (containing a little phenol) in a small, tight jar (atmosphere of 100% relative humidity) and, again, weighed daily. At point B the female was found to be relaxed sufficiently to be set and was spread and dried in the wooden box. It is notable, but familiar to all collectors, that the rate of drying after relaxation is very rapid. In a little over two days the female again had reached its constant weight, while about four days were required for the same loss of moisture during initial drying period. Probably this is explained by the difference in the location of the moisture in the insect; originally, it was diffusing out from the center of the body, but during relaxation water diffuses inward so that most of it is in the outer layers (all that is required for relaxation of the wings, antennae, etc.). Then drying is rapid as diffusion from near the surface proceeds quickly.



Drying and relaxation curves (weight vs. time)

The male was subjected to 100% relative humidity up to point C. At this time the body appeared well-soaked, and the weings were stained. However, after drying (in the box as before), the specimen looked quite as it had originally. This time the rate of drying was very great, constant weight being attained in two days.

At first thought, drying might be expected to be much more rapid over a drying agent. However, the mechanism of diffusion as mentioned would require that the relative humidity not affect the rate very greatly. To test this idea, another *D. plexippus* (female, fresh weight 0.647 gram) was dried in a small jar over Drierite (granular, anhydrous calcium sulfate, an efficient desiccant), *i. e.*, in an atmosphere of nearly 0% relative humidity. About eight days were required for attainment of constant weight; this is about 80% of the time needed at about 30-90% relative humidity. There seems to be no advantage in using drying agent in practice. Drying time is not lessened very much, and in the case of the above specimen the wings were shriveled and the antennae were extremely brittle.

Although no time-points were taken for other species, weight losses (ambient humidity for five to eight days) run 45 to 65% (Table I) in most

WEIGHT LOSSES ON DRYING AT AMBIENT HUMIDITY

Species	Fresh weight (grams)	Drying time (days)	Weight loss (%)
Papilio glaucus	0.37	8	49
Papilio polyxenes (3)	0.288, 0.314, 0.349	5	58, 45, 48
Papilio troilus	0.242	5	58
Cercyonis alope	0.072	6	58
Colias eurytheme (2)	0.101, 0.097	5	52, 60
Colias eurytheme (2)	0.102, 0.097	6	63, 65
Vanessa atalanta	0.286	5	57
Limenitis archippus	0.160	6	64
Phyciodes tharos	0.049	6	65

cases. Smaller species (not in table, which includes only a few of the weight-losses noted) dried more rapidly than larger ones, as expected (and well known to any collector).

In conclusion, it would seem that under normal (not persistently very humid) summer conditions the general pattern of drying and relaxation rates as shown in the graph might be expected to apply to most butterflies.

1327 Fall River Ave., Seekonk, Mass., U. S. A.