Preliminary notes on the humidity reactions of Myrrha 18-guttata L. (Col., Coccinellidae).

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Introduction.

HODSON (1937) suggested that the beetles *Coleomegilla maculata* DE GEER and *Hippodamia convergens* GUER. may select areas which are neither too wet nor too dry. The moisture content of the hibernacula media of both species was about 20 per cent and in experiments they preferred a water content of the same value (HODSON op.cit., pp. 283 – 285). HAGEN (1962, pp. 310 – 311) has briefly mentioned about the influence of desiccation on the humidity reactions of *Hippodamia convergens* beetles. Some other investigators (e.g. EWING 1913, TELENGA 1948) regarded humidity as one of the factors inducing dormancy. I have not been able to find any special investigations concerning the humidity reactions of coccinellids (*Myrrha 18-guttata* L. or other species). The purpose of this paper is to provide preliminary notes on my investigations concerning these reactions.

Material and methods.

The studies here described were made at the Zoological Institute of the University of Helsinki in the spring 1962. The material for laboratory experiments was acquired from a pine peat-bog situated in the western part (Haaga) of the town of Helsinki. Stumps about 0.5 m. long were cut from the butts of pines (10 – 20 cm in diameter). The stumps were brought to the laboratory, where *Myrrha 18-guttata* adults came out from the crevices in the bark. This happened in April, when there was still snow on the ground. The coccinellids were kept in glass jars with slightly damp blotting-paper at a temperature of about +6°C. At this temperature the specimens were wholly inactive. The coccinellids were fed on the diet recommended by SMIRNOFF (1958).

The apparatus used, based on those of GUNN & KENNEDY (1936) and WIGGLESWORTH (1941), was the alternative chamber described by PERTTUNEN (1953) and PERTTUNEN & LAHERMAA (1962).

13 pairs of humidities, obtained with concentrated salt solutions were used. The chemicals and the corresponding theoretical humidities at 20°C (JANISCH 1938) were as follows:

H_2O	100 % R.H.	$Ca(NO_3)_2$	56 % R.H.
KH_2PO_4	97 % R.H.	$MgCl_2$	34 % R.H.
KCl	87 % R.H.	Silica gel	0 % R.H.
NaCl	77 % R.H.		

The dishes with salt solutions were set up at least half an hour before the beginning of the experiments.

The animals were inserted into the apparatus through the hole in the lid, ten at a time, and their positions recorded at 15-minute intervals for two hours. For every alternative the number of specimens tested was 100.

The experiments were carried out at a temperature of about 20°C.

Results.

The intensity of the humidity reaction is expressed as the excess percentage on the moister side, $\frac{100\ (W-D)}{N}$ (cf. PERTTUNEN 1953), where W represents the number of animals (position records) on the moister side, D the number of records on the drier side, and N the total number of position records, including

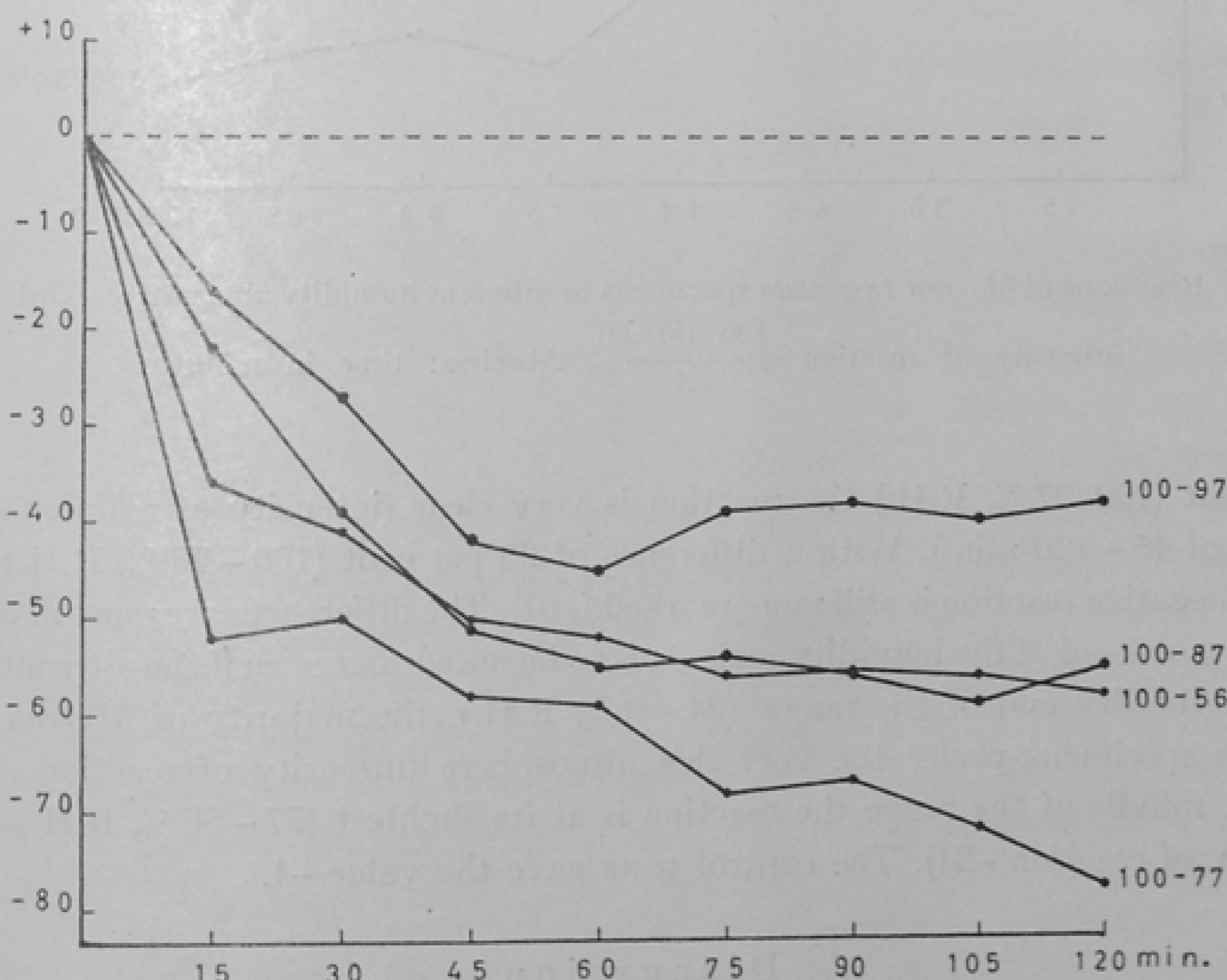

Fig. 1. Reactions of *Myrrha 18-guttata* specimens to different humidity alternatives. Ordinate: intensity of reaction $\frac{100\ (W-D)}{N}$. Abscissa: time in minutes.

the small number in the narrow middle zone. The broken line at 0 is the zero line of no reaction, the percentages above this (+) indicating a reaction towards moist, and the percentages below it (–) a reaction towards dry.

Figs. 1–4 show the reactions of *Myrrha 18-guttata* specimens to various alternative air humidities. The humidity reaction is always towards the drier alternative throughout the range of the humidity scale. Even with a difference of 3

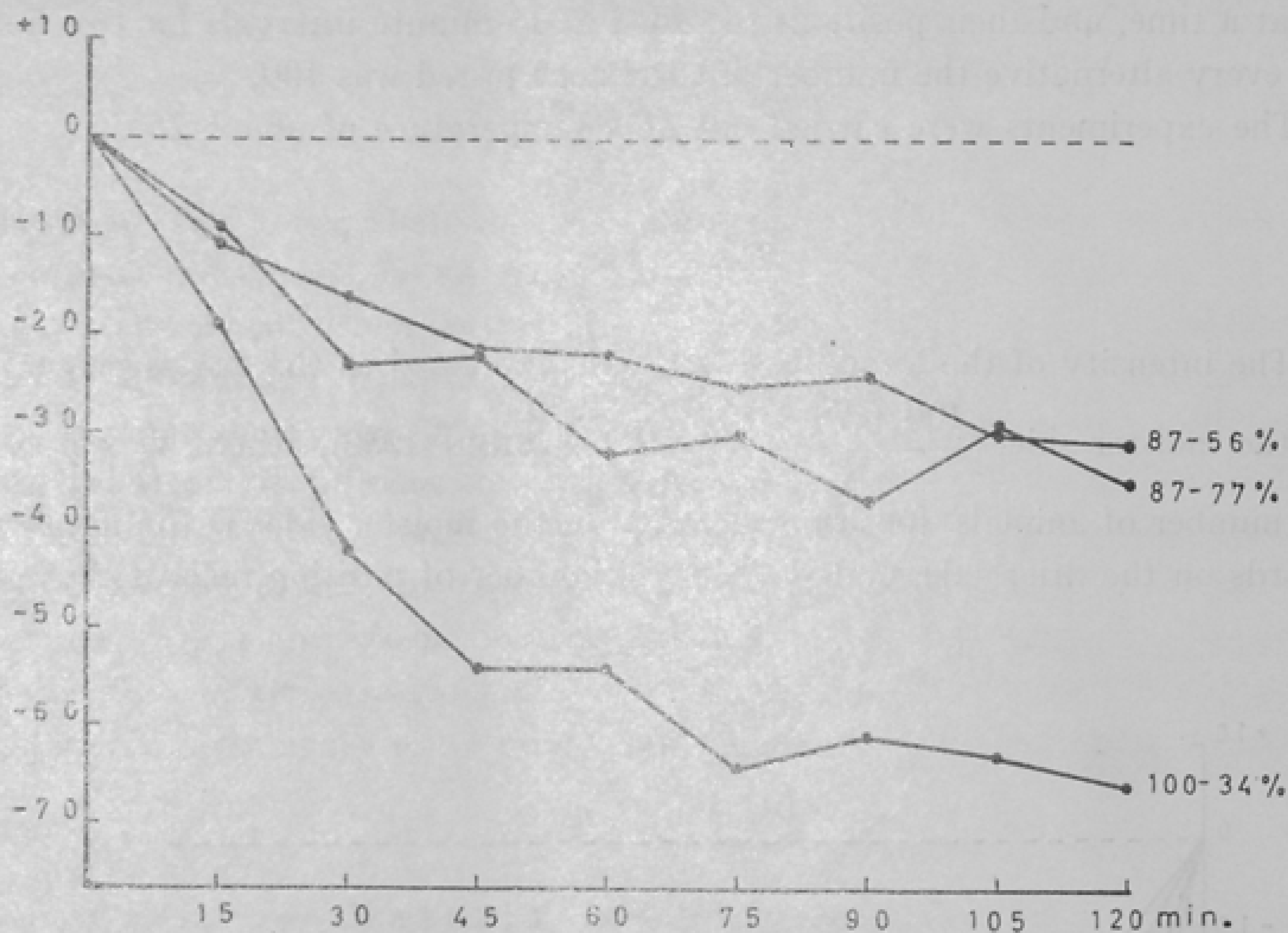

Fig. 2. Reactions of *Myrrha 18-guttata* specimens to different humidity alternatives. Ordinate: intensity of reaction $\frac{100\ (W-D)}{N}$. Abscissa: time in minutes.

per cent (100–97 % R.H.) the reaction is very clear (intensity of reaction –40, mean of 45 – 120 min.). With a difference of 23 per cent (100 – 77 % R.H.) the hygronegative reaction is still more marked (–67). The differences are most marked at the moist end of the humidity scale. It is to be noted that even if the alternatives are at the dry end of the range (34 – 0 % R.H.), the majority of *Myrrha 18-guttata* specimens prefer the very dry atmosphere (intensity of reaction –27). In the middle of the range the reaction is at its slightest (77 – 56 % R.H. – intensity of reaction –21). The control tests gave the value –4.

Discussion.

In order to test the theory that insects are not obliged to spend the winter in moist surroundings but that they show some definite preference, Hodson

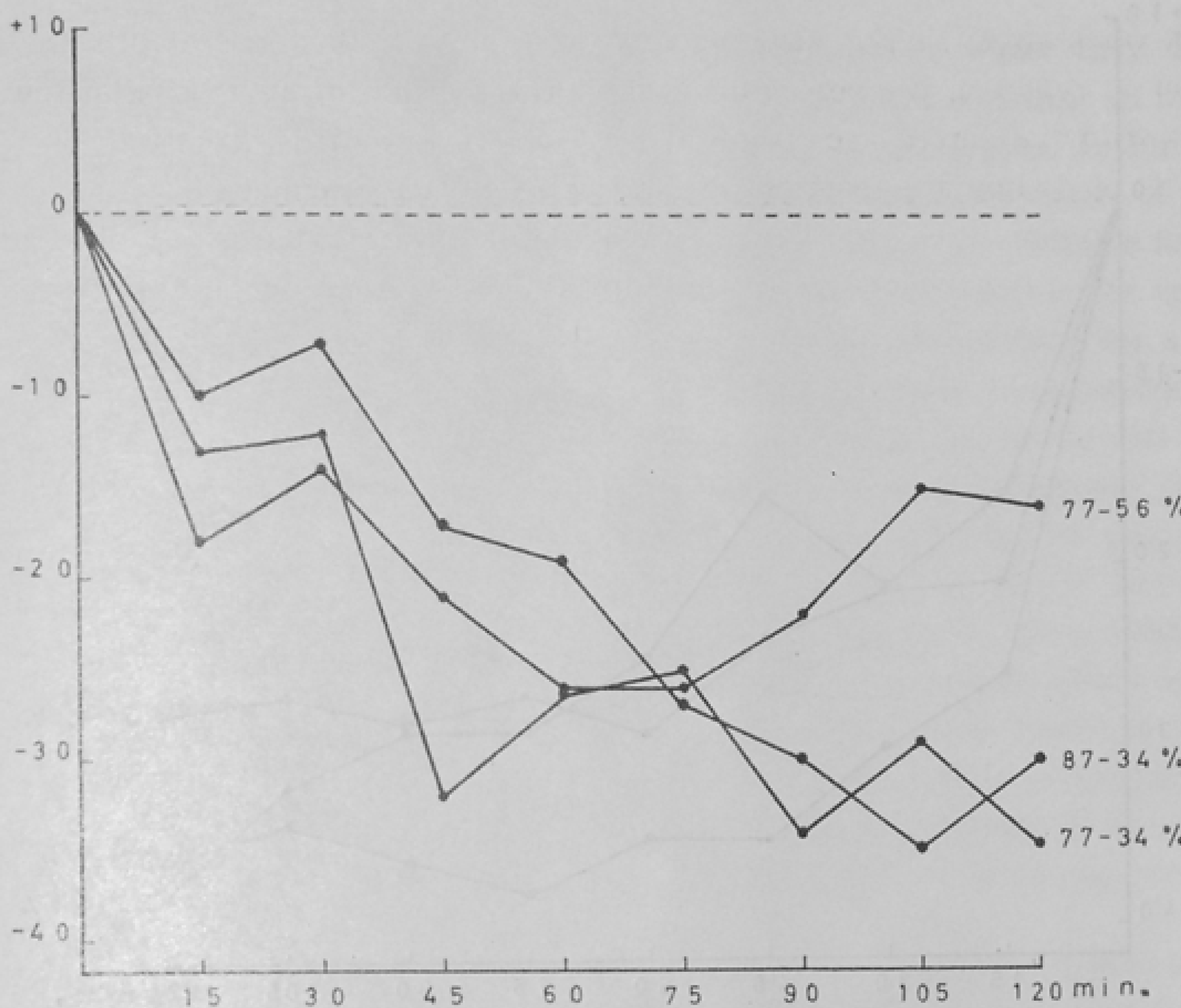

Fig. 3. Reactions of *Myrrha 18-guttata* specimens to different humidity alternatives. Ordinate: intensity of reaction $\frac{100\ (W-D)}{N}$. Abscissa: time in minutes.

(1937, pp. 284–286) studied the coccinellids *Coleomegilla maculata* DeG. and *Hippodamia convergens* Guer., among other insects. The insects were tested in a wire screen cage one foot square. The cage had a board floor divided into four equal parts with narrow, movable strips of wood. Samples of soil having moisture contents of zero per cent, 10 per cent, 20 per cent and 30 per cent were introduced into the compartments at the beginning of the experiment. The soil in each compartment was covered with a thin layer of leaves, and in each case the soil and leaves had the same moisture content. The arrangement of the different soils was varied. After the introduction of the artificial forest floor a known number of test animals was scattered at random on the leaves. When they had distributed themselves throughout the cage, it was placed in a low temperature cabinet, and the temperature allowed to drop very slowly from room temperature or above to a point at or near zero Centigrade. The experiments showed that the species studied can select areas which are neither too wet nor too dry. These species preferred soil having a moisture content of 20 per cent. In nature they were found in places which were similar with respect to the available moisture.

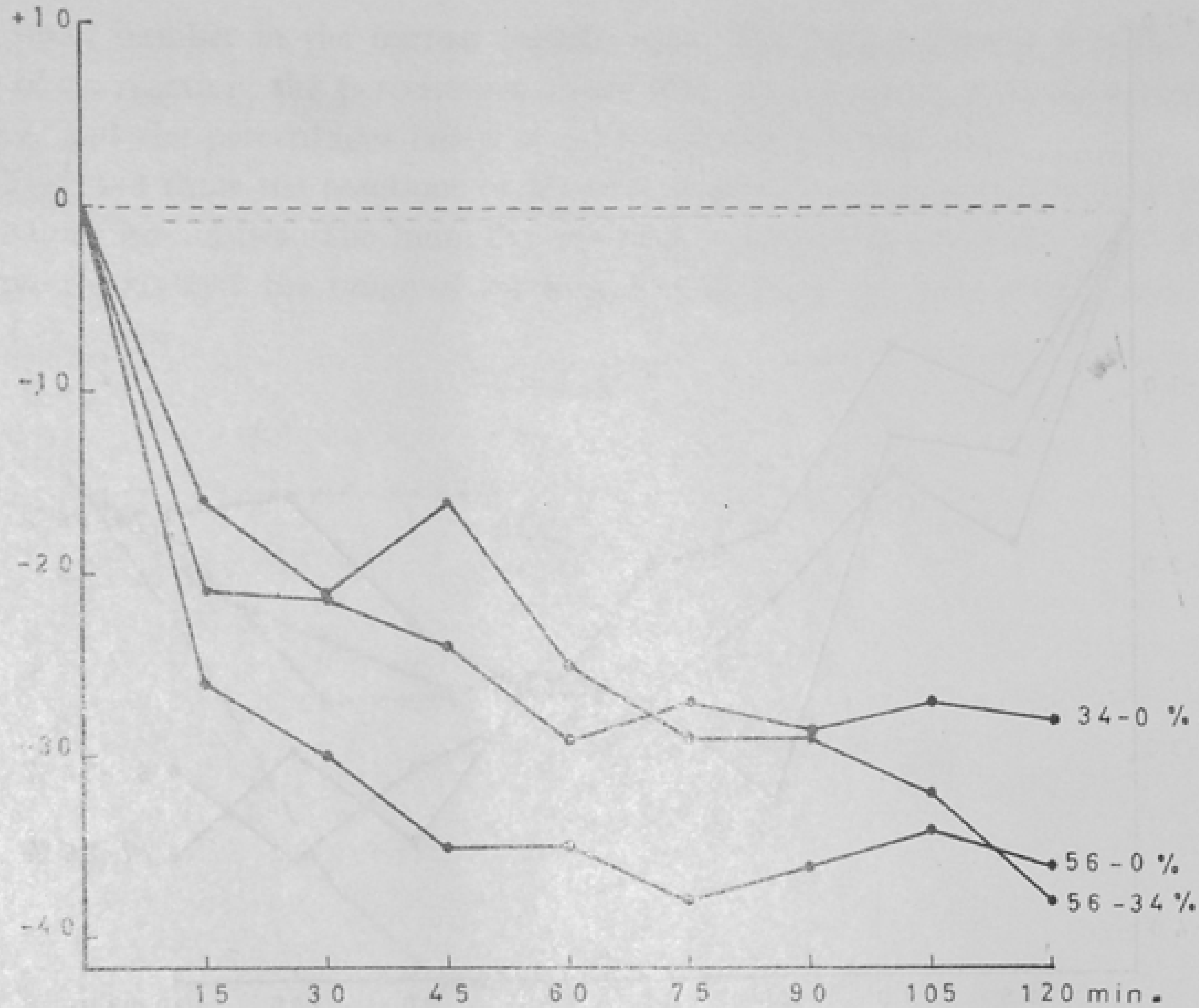

Fig. 4. Reactions of *Myrrha 18-guttata* specimens to different humidity alternatives. Ordinate: intensity of reaction $\frac{100\ (W-D)}{N}$. Abscissa: time in minutes.

Ewing (1913) observed that *Hippodamia* and *Coccinella* began to migrate to hibernation quarters (in Oregon, U.S.A.) when conditions became hot and dry in August. Telenga (1948) regarded low humidity and high temperature as factors inducing dormancy. Weiss (1913) and Park (1930) concluded that a fall in temperature caused *Coleomegilla maculata* to descend to the forest floor (cf. also Hawkes 1926). Delucchi (1955) observed that in Switzerland the temperatures became colder by early October and *Pullus impexus* Muls. coccinellids took up winter quarters under bark and remained there for about six months. According to my observations, *Myrrha 18-guttata* specimens begin to hibernate in September-October when the daily temperatures fall to a certain level. The mean daily temperatures are then clearly below +15°C. According to Hodson (1937), coccinellids can then find winter quarters with suitable moisture conditions. Hagen (1962, p. 310) measured the water content of the monthly samples of *H. convergens* beetles from Sierra Nevada (U.S.A.) aggregations and observed that it remained remarkably constant. Hagen (op.cit.) considered that the water balance was maintained by imbibing water. If the beetles from aggregations were kept in a refrigerator for a month or so, without litter, there was a distinct water loss. When these beetles were exposed to water they drank avidly. HAGEN (op.cit.) concluded that moisture availability was thus an important requirement in the aestivo-hibernating sites of *H. convergens*. In Finland, *Myrrha 18-guttata* hibernates at least in the crevices of bark in the butts of pines in peat-bogs. It is likely that the moisture conditions there are suitable for the hibernation of this species (cf. HAGEN 1962). When the snow melts in the spring, the relative humidity around the winter quarters of *M. 18-guttata* is for a long time very high (about 100 % R.H.). The pine butts may even be surrounded by water. When the temperature has risen to a certain degree, the specimens leave their winter quarters (cf. *Blastophagus piniperda* L., which hibernates in the butts of similar pine trunks; PERTTUNEN 1960). The experiments of this study were made with specimens which under natural conditions would have left their winter quarters after some days. It is not surprising that in these conditions the specimens showed a clear hygronegative reaction (cf. *Schizophyllum sabulosum*; PERTTUNEN 1953). In nature, some days after leaving the winter quarters, *M. 18-guttata* specimens were found in the tops of pines in the neighbourhood, where the relative humidity was lower than in the winter quarters of the species at the same time (concerning the natural summer habits of the species, see KANERVO 1940, 1946).

HODEK and ČERKASOV (1958) regard a relative humidity of 50 – 70 per cent as one of the optimal breeding conditions of *Coccinella septempunctata* L. (see also HODEK 1958, 1960). In my experiments the humidity reaction of *M. 18-guttata* was at its slightest in these alternative humidities.

These investigations are to be continued in the near future.

Summary.

1. The reactions of *Myrrha 18-guttata* coccinellids to differences in the relative humidity of the air (altogether 13 pairs of humidities) were studied in the alternative chamber. The material for laboratory experiments was collected from the hibernation quarters of the species (from crevices in the bark of pine butts in a peat-bog in April).

2. The beetles showed a reaction towards the drier side of the chamber when different humidity alternatives were offered. The reaction was at its maximum when the alternatives were 100 and 77 % R.H. When the higher alternative was 100 % R.H., the beetles could perceive a difference of 3 per cent. A clear reaction was also obtained with alternatives of 34 and 0 % R.H.

3. The ecological significance of the humidity reactions of the species in its natural environment is discussed.

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