cortex during learning or light stimulation[13–21]. Most of them differ, however, in many respects from the paradigm explored in the present study (early life period, total dark versus strong light stimulation, very often control and expt. groups treated separately, correction of the precursor changes made almost exclusively at one fixed time interval measuring total TCA soluble radioactivity even when tritiated amino acid used). Nonetheless, differences in the pool of some amino acids[22], blood flow[23] and blood-brain barrier permeability[24] between light restricted and stimulated visual cortex revealed from these kinds of experiments might contribute to the changes in TCA-soluble activity detected in our experiments.

Zusammenfassung. Ratten lernten mit einem Auge eine horizontal-vertikale Diskrimination. In der optischen Hirnrinde, kontralateral zum offenen Auge, konnte bereits 15 min nach Applikation von ^{14}C-Leucin eine kleine, aber statistisch signifikante Erhöhung der Proteinmarkierung sowie eine Verminderung der Radioaktivität in der Trichloressigsäure-löslichen Fraktion gefunden werden.

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Pattern in the Hunger Signal of Hornet Larvae (*Vespa orientalis*)

In previous publications the nature of the hunger signals produced by larvae of the oriental hornet (*Vespa orientalis*) was reported[1–3]. It was found that the pattern of contractions of the larvae when producing spontaneously the hunger signals is rhythmic and the average between consecutive contractions is 3 to 4 sec. In the present experiment, the pattern of contractions induced by a mechanical stimulus was studied.

Materials and methods. 3 hornet queen larvae were kept in their optimal natural conditions in separate combs to prevent the transfer of signals from one to the other. The experiment continued for 8 days: during the first 6 days the larvae were completely starved and during the latter 2 days they were fed. On each day a series of mechanical stimuli were presented to the larvae. Initially a light knock was given to the back of the comb by a vibrator. Consequently a series of bodily contractions was observed and recorded by a pick-up transducer (B & K) attached to a tape recorder (Philips) and to a polygraph (Grass). When a series of contractions was followed by a relatively long interval (5-10 min) containing no contractions, the stimulus was repeated and the results again recorded. This cycle of stimulus and recorded response was continued for a one-half-hour period on each day for each larva.

Results. In Figure 1 three typical series of signals induced by stimuli are presented. In the top trace the series is relatively short and contains a total of 12 contractions. The series is preceded by a period of resting which was followed by the stimulus. Another period of rest follows the series. The interval between the first and second contraction is about 2 sec, whereas the interval between the last 2 signals is about 4–5 sec. In the other two traces there is a similar lengthening of the intervals between contractions as the series continued, although the number of contractions and the absolute length of the series differ (Figure 1).

32 series of contractions, each of which contained at least 30 signals, were analyzed. If a relationship can be

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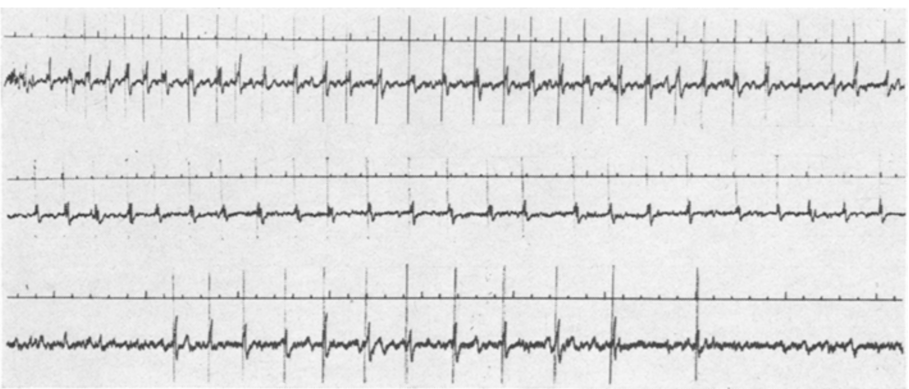

Fig. 1. The polygraph tracing of the recordings of 3 typical series of contractions. The upper line in each tracing is a timer, each interval represents 1 sec. The vertical lines are drawn to designate the start of the contractions.

described between the time between 2 consecutive intervals and the index number of the signal, then the hypothesis that the signals are distributed according to a Poisson distribution does not hold. Therefore a regression analysis was performed using the rate (1/time) between signals as the dependent variable and the index of the signal as the independent variable. In Figure 2, we present 6 such series. The correlation of the linear regression was highly significant ($p < 0.005$) in all but 2 cases (both of which were recorded on the 8th day for the same larva). For most of the series, the addition of a quadratic term to the regression was not significant. The Table gives several of the regression equations calculated from the various series. As can be seen from the Table, the intercepts of the regression (a) are of the same magnitude. All the slopes are negative, which indicates that the rate decreases as the series increases and therefore the time between signals increases as the series continues. For purposes of comparison the mean time interval for the first and last 10 intervals were also computed. The ratio of the last 10 to the first 10 varies from 1.1 to 3.7. Excluding day 8 no clear pattern can be seen in the variation of the coefficients of the regression with day of experiment, nor was any pattern found for variation between series of the same day.

Discussion. Maturation (pupation) of hornet larvae can be delayed by starving them. This allows repeated observations to be made on them. The larvae were starved for periods lasting 6 days during which they remain in apparently good condition[4]. A single mechanical stimulus, resembling that produced by a larva when begging for food, results in a chain of repeated isotonic contractions. During each contraction the larva reaches the cell wall with its mandibles and produces a scratching noise – the hunger signals. Each contraction is followed by a period of relaxation during which the larval body returns to its initial position, hanging upside down in the comb cell. The larval contraction is a behavioural reflex

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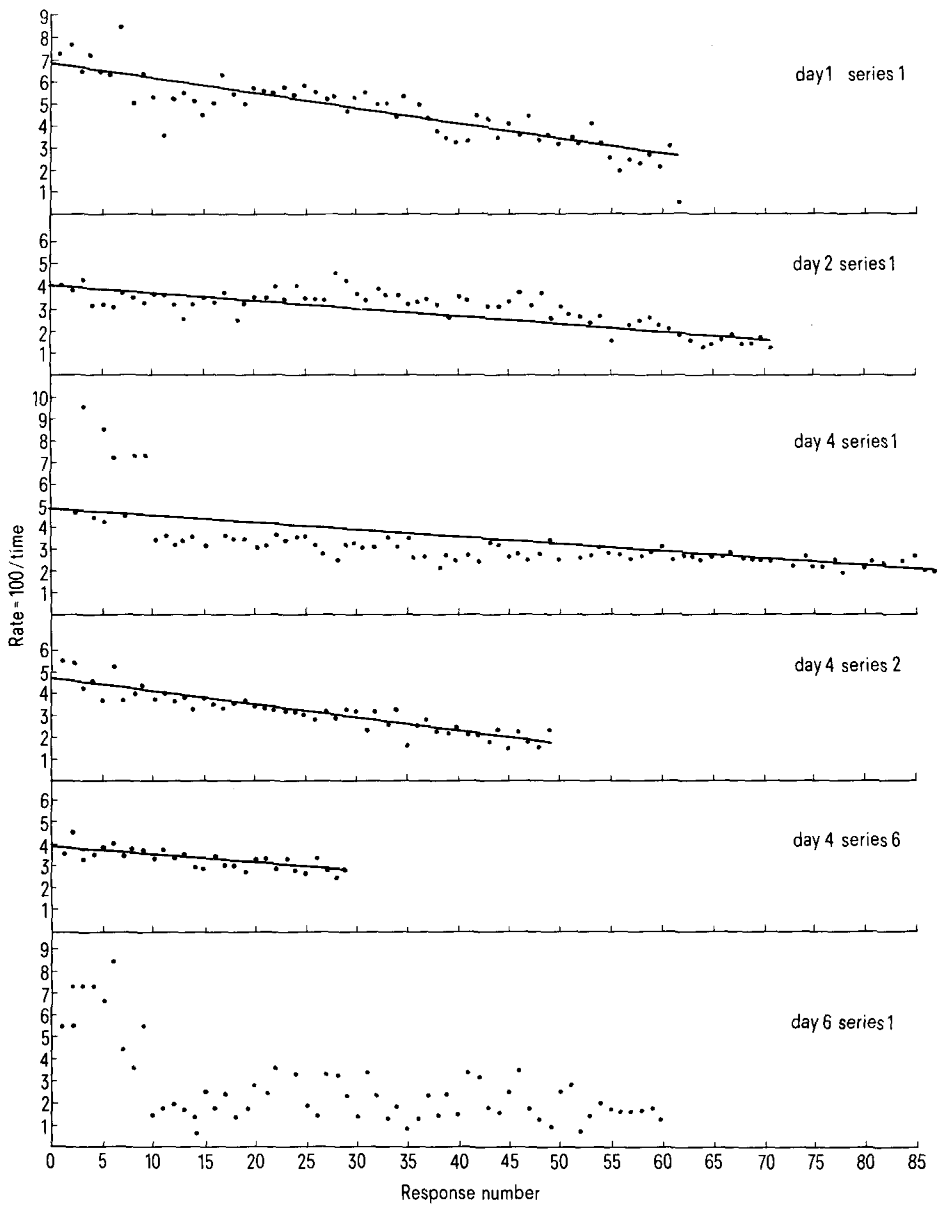

Fig. 2. Rate (100/time) between intervals for several series of larva 3. The straight lines represent the regression lines given in the Table. The bottom trace is a sequence for which a straight line is not an adequate fit; a second order polynominal is preferable.

Detailed analysis of the responses to 17 of the stimuli presented to the larvae (*Vespa orientalis*)

Larva	Day of experiment	Series within day	No. of contractions (signals)	r[a]	b[b]	a[b]	Average time[c] between 1st 10 signals	Average time[c] between last 10 signals
2	1	1	60	0.77	–.0007	0.075	13.4	29.3
	2	1	133	0.81	–.0004	0.066	12.8	47.7
	3	1	69	0.94	–.0009	0.080	12.2	36.1
	7	1	134	0.71	–.0002	0.051	15.2	49.4
	8	1	57	0.26	–.0001	0.048	20.7	22.7
	8	9	69	0.28	–.0002	0.049	19.3	23.3
3	1	1	61	0.87	–.0007	0.068	15.0	34.7
	2	1	71	0.65	–.0003	0.040	29.2	61.6
	3	1	57	0.78	–.0007	0.056	18.5	46.4
	4	1	86	0.69	–.0004	0.049	15.9	45.3
	4	2	49	0.92	–.0006	0.047	22.2	51.1
	4	3	32	0.77	–.0007	0.038	28.4	51.2
	4	4	30	0.80	–.0003	0.034	30.4	38.0
	4	5	33	0.72	–.0004	0.037	27.9	37.6
	4	6	29	0.81	–.0004	0.038	27.8	36.2
	5	1	52	0.47	–.0002	0.029	34.6	47.5
	6	1	34	0.62	–.0013	0.054	17.8	45.2

[a] r, correlation coefficient. [b] The regression equation is $Y = a + bx$ where Y = rate between the intervals; and x = index number of the signal. [c] The harmonic mean of the first and last 10 times.

mediated by some, as yet unknown, motorneurones. It occurs both spontaneously and as a result of sensory stimulation. Analogous behaviour is known in other species of Vespinae and is part of the food exchange phenomenon called trophallaxis[5].

The series of isotonic contractions resulting from a mechanical stimulus does not have a constant time difference between successive contractions. As the series continues, the length of time between contractions increases (or the rate decreases). However, the amplitude of the signal is constant for each contraction in the series. Therefore, this is not similar to fatigue and most likely represents an adaptation process similar to that occurring in the optic nerve fibre of *Limulus* in response to a flash of light[6]. A second phenomenon similar to an adaptation process is seen in the response to the repeated stimuli on the same day. The number of contractions in the response to the earlier stimuli is greater than in the latter stimuli. This trend also appears in many other series (ISHAY, unpublished).

This experiment was performed on single insulated larvae. The results contrast with the pattern of hunger signals produced in a normal comb (inhabitated by many larvae). The latter's pattern is synchronized for large groups of the larvae. This synchronized pattern is at constant rate[2] in contrast to the insulated larvae's pattern. The intervals between the signals of single insulated larvae vary over a broad range of values from 1.5–5.5 sec; this represents most probably the result of removal of synchronizing stimuli. The possible communicative value of these patterns of larval contractions among the colony mates will be examined in further research.

Summary. A mechanical stimulus of constant strength was applied to a single, insulated hornet larvae (*Vespa orientalis*). A chain of at most 140 bodily contractions resulted from the stimulus. The interval between consecutive contractions steadily increased throughout the period of response.

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Role of Energy Metabolism in Enzyme Retention. A Study on Isolated Perfused Canine Hearts

Little is known of the mechanisms by which enzymes are released from normal or damaged cells. There is evidence that the prevention of enzyme leakage is directly or indirectly an energy-consuming process[1–4]. In the myocardium an unequivocal relation between enzyme release and duration of ischemia can be shown[5,6]. A close relationship exists also for enzyme loss and oxygen supply to the heart. The temperature coefficients (Q_{10}-values) for myocardial enzyme release and the breakdown of energy rich phosphates in the heart muscle during anaerobiosis ($\sim$ 2,2) are identical (unpublished results).

In the following the correlation between the rate of enzyme loss from the heart and the myocardial ATP content will be shown.

Ten isolated dog hearts were subjected to a non-recirculatory anoxic perfusion at 25 °C with a modified Tyrode-solution after an aerobic steady state phase. In 5 experiments the release of CPK (EC 2.7.3.2.), MDH (EC 1.1.1.37), LDH (EC 1.1.1.27), GOT (EC 2.6.1.1.), GPT (EC 2.6.1.2.), ALD (EC 4.1.2.13), and ICDH (EC 1.1.1.42), in the remaining experiments the tissue contents of creatine phosphate, ATP and lactate during anaerobiosis