

vasodilatation, were, on the contrary, hypothermic. Only after CCh could all thermoregulatory responses studied be uniformly attributed to hypothermia.

The naturally-occurring complementary relationship between insulative and thermogenic mechanisms¹⁰ was no longer shown after application of drugs; the correlation coefficient between 1-min means of FI and integrated EMG-activity was -0.157 (NS) after NA, and after 5-HT

and CCh even highly positive (0.404 , $p < 0.05$, and 0.959 , $p < 0.001$, respectively).

In conclusion, our results suggest that intrahypothalamic injections of NA, 5-HT and CCh have either direct or indirect effects on feather position in the pigeon. Ptilomotor changes seem to be well related to the drug-induced changes in the arousal state, but the relation to shivering thermogenesis seems to be variable.

- 1 Acknowledgment. This work was supported by the Emil Aaltonen Foundation.
- 2 R. Hissa and W. Rautenberg, *J. Physiol., Lond.* 238, 421 (1974).
- 3 R. Hissa and W. Rautenberg, *Comp. Biochem. Physiol.* 51A, 319 (1975).
- 4 A. Pyörnilä, H. Lahti and R. Hissa, *Neuropharmacology* 16, 737 (1977).
- 5 A. Pyörnilä and R. Hissa, *Experientia* 35, 59 (1979).
- 6 P. Stettenheim, in: *Avian Biology*, vol. 2. Academic Press, New York 1972.

- 7 D. McFarland and P. Budgell, *Physiol. Behav.* 5, 763 (1970).
- 8 H.J. Karten and W. Hodoss, *A Stereotaxic Atlas of the Brain in the pigeon (Columba livia)*. Johns Hopkins Press, Baltimore 1967.
- 9 D. McFarland and E. Baher, *Anim. Behav.* 16, 171 (1968).
- 10 E. Hohtola, H. Rintamäki and R. Hissa, *J. comp. Physiol.* 136B, 77 (1980).
- 11 D. Morris, *Behaviour* 9, 75 (1956).
- 12 R.W. Hill, D.L. Beaver and J.H. Veghte, *Physiol. Zool.* 53, 305 (1980).

Conditioning of depressor responses evoked by single volleys in the aortic nerve

K. Lupa, G. Wójcik and A. Niechaj

Department of Human Physiology, Medical School, PL-20-080 Lublin (Poland), 9 February 1981

Summary. Depressor responses evoked by single volleys in the aortic nerve are more facilitated by conditioning volleys exciting C fibers in the same aortic nerve than in the contralateral one. Conditioning volleys in A fibers do not facilitate the testing depressor responses.

Depressor responses evoked by activation of the aortic nerve were studied mainly under conditions of repetitive stimulation. This kind of stimulation produces temporal facilitation in the vasomotor centers and results in prolonged changes of their excitability. The duration of these changes was determined in interaction experiments with 2 repetitive stimulations applied to the same aortic nerve. It was found that at durations of stimulations amounting to 20 sec the effect of a conditioning stimulation on the size of the testing response is visible even when the interval between them exceeds 180 sec¹. In contrast to these results the effect of single volleys in the aortic nerve is much less conspicuous. Single volleys in A fibers do not produce any changes in the arterial blood pressure. Douglas et al.² observed that when the strength of a single pulse is sufficient to excite non-myelinated afferents (C fibers) small blood pressure falls are encountered in approximately half of animals. These findings indicate liminal activation of the vasomotor mechanisms. We have tried to assess the extent of this activation by employing the technique of conditioning. For this purpose the testing depressor responses, evoked by single volleys in the aortic nerve, were preceded by volleys in the same or the contralateral aortic nerve.

Material and methods. 33 rabbits were anaesthetized with urethane (1.3 g/kg) and vagotomized. The arterial blood pressure was measured in the femoral artery. The right and left aortic nerves were identified electrophysiologically and each of them mounted on the pair of platinum stimulating electrodes. The nerves were covered with warm paraffin oil. Single rectangular pulses of 1-msec duration were used for conditioning and testing stimulation. The strength of pulses evoking testing depressor responses amounted to 10 V and was supramaximal for activation of C fibers³. The intensity of conditioning pulses was either the same or lower (usually 3 V) to activate only A fibers. The intervals between the pairs of pulses were not shorter than 5 min.

Results and discussion. Single volleys activating C fibers in the aortic nerve usually evoke very small and variable depressor responses. To make an analysis of their changes during conditioning easier we have taken into consideration the results from animals in which the size of the testing blood pressure falls was equal to or exceeded 10 mm Hg. It was found that depressor responses of that size appeared in 12 out of 33 rabbits, i.e. in 36%. The records of figure 1A and the upper curve of figure 2 demonstrate the changes in the size of the testing depressor responses when both conditioning and testing volleys are applied to the same aortic nerve. At a testing interval of 8 msec the size of the depressor response amounts to 125% of the control. At longer intervals between volleys the testing response rises abruptly to reach its maximum of 231% at the interval of 128 msec. With further lengthening of the intervals between volleys the decline of the testing response is observed and at 1024 msec its size is similar to that observed at 8 msec. The records of figure 1B and lower curve of figure 2 show

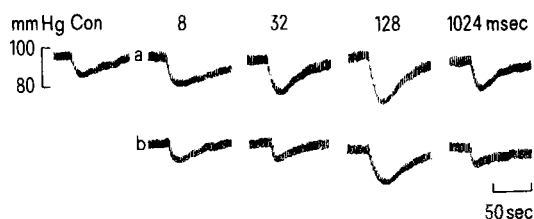


Figure 1. Conditioning of depressor responses by volleys in the same (A) and contralateral (B) aortic nerve. The depressor responses were evoked by single volleys exciting C fibers of the aortic nerve. The 1st record (Con) shows the test depressor response not preceded by a conditioning volley. The following records illustrate conditioning of the depressor response. Numbers above the records indicate intervals between conditioning and testing volleys.

that conditioning volleys in the contralateral aortic nerve delay and diminish facilitation of the testing response. The testing depressor response starts to increase at an interval of 32 msec and reaches its maximum of 188% at 128 msec. At that point the depressor response is rapidly decreased and starting from an interval of 1024 msec the response is diminished below the control value. At intervals between 16 and 128 msec differences between mean sizes of depressor responses conditioned by volleys in the same and in the contralateral aortic nerve are statistically significant.

In several preparations the strength of the conditioning pulses was decreased to excite only myelinated aortic afferents. These volleys applied to the same or contralateral aortic nerve (open and filled squares of fig. 2) did not affect the size of the testing response which did not deviate significantly from the control in either testing interval.

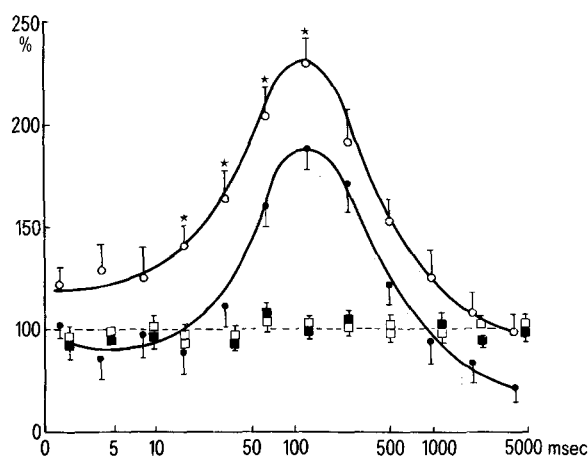


Figure 2. Changes in the size of depressor responses produced by conditioning volleys in the aortic nerves drawn using a semilogarithmic scale. The testing depressor responses were evoked by single volleys exciting C fibers in the aortic nerve. They were preceded by identical volleys in the same aortic nerve (○—○) and in contralateral aortic nerve (●—●). Note the lack of effects of conditioning volleys activating A fibers in the same (□—□) and in the contralateral aortic nerve (■—■). Abscissa, intervals between conditioning and testing volleys in msec. Ordinate, the size of the testing response expressed in percentages of the control response not preceded by conditioning volleys and taken as 100. The intervals between conditioning and testing volleys were in geometric series (2, 4, 8 ... 4096 msec). Different testing intervals were studied in random sequence. Each point represents the mean \pm SEM of 12 experiments. *Significantly different ($p < 0.05$) from depressor responses when the conditioning volley was applied to the contralateral aortic nerve.

Recent studies have shown that there is synergistic interaction between blood pressure responses to repetitive stimulation of A and C fibers in the aortic nerve³. The lack of effect of conditioning volleys in A fibers indicates that facilitation of depressor responses seen in our experiments is solely related to activation of C fibers. We have obtained a smaller percentage of rabbits responding by depressor responses to volleys activating C fibers than has been reported by other authors². This divergence, which is of a quantitative character, may be explained by different experimental methods. The time course of facilitation of depressor responses evoked by single conditioning volleys in the same aortic nerve is about 40 times shorter and in the contralateral nerve about 180 times shorter than when the interaction of responses produced by repetitive stimulations is studied¹. It is, however, similar to the time course of changes in spinal polysynaptic responses conditioned by single volleys and of changes in the sympathetic reflex discharge preceded by single shocks in a somatic nerve⁴⁻⁶. This comparison gives an idea of the extent of excitation of the vasomotor mechanisms by single volleys. Taking into account the latencies of evoked potentials in the brain stem which were produced there by stimulation of the aortic nerve and the fact that bulbospinal pathway responsible for blood pressure falls is very slow⁷⁻⁹, our data suggest that single volleys in C fibers excite relatively small number of neurones and thus evoke a very restricted activation of the vasomotor mechanisms. Evoked potentials recorded from the brain stem by stimulation of low-threshold baroreceptor afferents show stronger interaction with potentials produced by ipsilateral than by contralateral baroreceptor fibers⁸. The smaller facilitatory effect of volleys in the contralateral aortic nerve confirms these results and extends their validity to interactions between volleys in non-myelinated aortic afferents.

- 1 A. Niechaj and S. Dyba, *Archs int. Physiol. Bioch.* 82, 663 (1974).
- 2 W.W. Douglas, J.M. Ritchie and W. Schaumann, *J. Physiol., Lond.* 132, 187 (1956).
- 3 H. Aars, *Acta physiol. scand.* 110, 315 (1980).
- 4 J.C. Eccles, P.G. Kostyuk and R.F. Schmidt, *J. Physiol., Lond.* 161, 258 (1962).
- 5 W. Holobut and A. Niechaj, *J. Physiol., Lond.* 230, 15 (1973).
- 6 A. Sato, N. Sato, T. Ozawa and B. Fujimori, *Jap. J. Physiol.* 17, 294 (1967).
- 7 A.K. Hellner and R.v. Baumgarten, *Pflügers Arch.* 273, 223 (1961).
- 8 M. Gabriel and H. Sellar, *Pflügers Arch.* 318, 7 (1970).
- 9 J.H. Coote and V.H. McLeod, *J. Physiol., Lond.* 241, 477 (1974).

Spruce budworm: Effects of different blends of sex pheromone components on disruption of male attraction

C.J. Sanders

Department of the Environment, Canadian Forestry Service, Great Lakes Forest Research Centre, P.O. Box 490, Sault Ste. Marie (Ontario, P6A 5M7 Canada), 10 November 1980

Summary. Disruption of attraction of male *Choristoneura fumiferana* to the natural sex pheromone in an atmosphere permeated by blends of the 2 pheromone components is greatest with ratios of the 2 components close to the natural blend.

Evidence has recently been presented by Schmidt et al.¹ showing that the degree of disruption of male *Choristoneura fumiferana* (Clem.) in atmosphere permeated by blends of the 2 pheromone isomers, (E)- and (Z)-11-tetradecenal

(TDAL), is independent of the (E):(Z) ratio. This is in contrast to earlier results with *Argyrotaenia velutinana*² and we have therefore carried out further experiments on disruption of *C. fumiferana* with different isomer ratios.