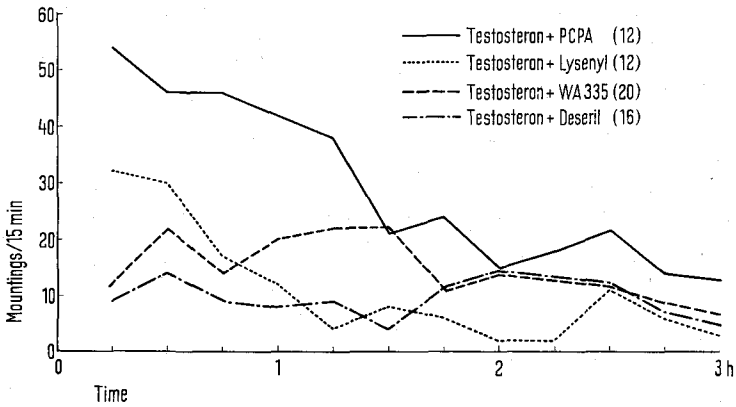

Observation of mounting behaviour for 3 h. Number of rats in parentheses brackets. There were 4 rats in each cage. After testosteron alone (12 rats) 2 rats exhibited mounting behaviour only very occasionally – on an average of once every $^1/_4$ h. The curves demonstrate all of the respective averaged values for the number (in parantheses) of rats.

(10 mg/kg) was given s.c. 4 times in periods of 24 h, the last dose being $5^1/_2$ h before the beginning of the observation. Testosteron-propionate was dissolved in sesame oil. PCPA ester (100 mg/kg) was injected i.p. thrice in periods of 24 h; the last dose being 24 h before the beginning of the observation. Methysergide (1 mg/kg i.p.) was injected 2 h, mesorgydine (0.5 mg/kg i.p.) 2 h and WA 335-BS (0.1 mg/kg i.p.) 2 h before the beginning of the observation.

Results. It was shown (Figure) that testosteron plus PCPA induce the strongest increase in mounting behaviour. Mountings are especially frequent in the first $1^1/_2$ h. After mesorgydine, WA 335-BS and methysergide in the combination with testosteron mountings were less frequent in the first $1^1/_2$ h compared with PCPA. In the last observation period, mounting behaviour decreased slowly. 12 rats received testosteron only; 2 rats exhibited mounting behaviour only very occasionally – on an average of once every $^1/_4$ h. After PCPA, mesorgydine, WA 335-BS and methysergide alone the rats showed significantly less frequent mounting behaviour than after combination with testosteron.

Minimally increased sexual behaviour was also seen after mesorgydine only by PODVALOVA and DLABAC[15]. After the treatment with parachloromethylamphetamine, which has been shown to decrease rat brain serotonin, testosteron-pretreated rats also displayed sexual excitement[16]. Mounting behaviour in male rats was also observed after lowering brain serotonin level with reserpine in combination with a peripheral DOPA-decarboxylase inhibitor (Ro 4-4602) plus L-DOPA[17].

Our results and the observations quoted tend to the conclusion that the antiserotonin effect (in combination with testosteron) could have a causative import in the activation of mounting behaviour in male rats. This would imply that the mounting behaviour cannot be solely caused by the specific effect of PCPA.

Zusammenfassung. «Mounting behaviour» bei Ratten wird nicht nur durch die Kombination Testosteron plus Parachlorphenylalanin hervorgerufen. Auch durch die Gabe von Testosteron in Kombination mit den Substanzen Mesorgydin, WA 335-BS und Methysergid, die unter anderem antiserotonergen Effekt haben, wird «mounting behaviour» bei männlichen Ratten ausgelöst. Aufgrund dieser Ergebnisse und zitierten Beobachtungen ist eine ursächliche Bedeutung zwischen dem Anti-Serotonin-Effekt und der Aktivierung des «mounting behaviour» bei männlichen Ratten anzunehmen. Die spezifische Wirkung der Substanz PCPA allein kann für dieses Verhalten nicht verantwortlich gemacht werden.

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[16] A. BERTOLINI and W. VERGONI, Riv. Farmac. Ter. *1*, 423 (1970).
[17] O. BENKERT, A. RENZ and N. MATUSSEK, Neuropharmacology, in press.

Dissociation of Vertical and Horizontal Components of Activity in Rats Treated with Lithium Chloride

JOHNSON and WORMINGTON[1] have shown that lithium chloride reduces the frequency of vertical rearing activity exhibited by rats. In the present experiments lithium-induced effects on vertical rearing are contrasted with effects on horizontal locomotory activity in the same subjects, and the relationship between rearing and environmental stimulation is examined.

Materials and methods. Experiment 1. The experimental subjects were 20 100-day-old Roman control strain (RCA) rats. The apparatus consisted of a vertical transparent tube, 46 cm tall, 23 cm internal diameter. The ceiling and floor of the tube formed the 2 plates of a capacitor which was linked to a proximity meter giving a voltage output linearly related to the distance between the tube ceiling and the head of a subject placed in the tube. This voltage was recorded on a moving pen recorder, producing an analogue print-out curve of the animal's rearing activity. Rearing frequency was determined as the number of peaks on this curve in a 5-min-test-session.

[1] F. N. JOHNSON and S. WORMINGTON, Nature, Lond. *235*, 159 (1972).

Horizontal movements of the animal in the tube caused the floor to tip about a central pivot, triggering 4 microswitches. Total switchings over a 5-min-period gave an index of horizontal locomotory activity.

On each day of the experiment the subjects received i.p. injections of either lithium chloride solution or placebo. The lithium chloride was dissolved in water for injection BP which was also used as placebo. Doses of 6 meq Li/kg were used, 0.1 ml/100 g subject body weight. Each subject was injected 15 min before testing. The subject was placed in the test apparatus 30 sec before recording commenced. Each subject was tested for 5 min per day on each of 6 successive days. For the first 3 days (phase 1) the subjects were randomly allocated to 2 groups, each of 10 subjects. Group 1 received injections of lithium chloride, whilst group 2 received placebo. For the following 3 days (phase 2) groups 1 and 2 were each split into 2 equal-sized subgroups. Group 1A continued to receive lithium chloride, whilst group 1B subjects were transferred to placebo: Group 2A continued to receive placebo, whilst group 2B subjects were transferred to lithium chloride. The experimental design was thus a modified 2 (phases) $\times$ 3 (days per phase) $\times$ 2 (1st drug) $\times$ 2 (2nd drug) factorial with a cross-over component, replicated 5 times and having repeated measures on the first factor.

Results. Lithium-treated subjects showed rearing frequencies lower than those of placebo-treated controls (Table I). This difference was highly statistically significant for both phases ($P < 0.001$). Subjects given placebo in phase 1 had much reduced rearing scores in phase 2 if given lithium chloride ($P < 0.01$). Those transferred from phase 1 lithium chloride treatment to placebo in phase 2 produced significantly higher rearing frequencies than did subjects remaining on placebo throughout both phases ($P < 0.05$). The rearing scores of group 2A subjects (placebo in both phases) fell progressively over the 6 days, there being a significant linear trend component ($P < 0.001$). The effect of crossing over drug treatments in phase 2 showed up as a phase $\times$ 1st drug interaction ($P < 0.001$) and a phase $\times$ 1st drug $\times$ 2nd drug interaction ($P < 0.01$). No other terms attained significance in the analysis of variance. No drug effects were noted on horizontal activity, nor did this activity change significantly over the 6 days of the experiment.

Experiment 2. It might be suggested that the effects found in Experiment 1 could be due merely to over-all activity suppression resulting from generalized lithium toxicity[2] and that the differential drug effect on rearing and locomotory activity was artifactual, reflecting a relative insensitivity of the horizontal activity recording mechanism. A second experiment was undertaken to clarify this point.

[2] M. NACHMAN, J. comp. Physiol. Psychol. *73*, 22 (1970).

Table I. Components of activity of rats under lithium chloride or placebo treatment on 6 consecutive daily test periods

Activity component	Phase 1				Phase 2			
	Group	Day 1	2	3	Group	Day 1	2	3
Vertical	1 Lithium	11.2	12.0	12.2	1A Lithium	11.0	16.6	12.9
					1B Placebo	49.1	46.2	48.2
	2 Placebo	49.6	47.2	36.4	2A Placebo	37.1	35.5	40.0
					2B Lithium	17.1	11.6	19.9
Horizontal	1 Lithium	48.0	53.3	50.1	1A Lithium	45.4	45.2	50.3
					1B Placebo	58.6	67.7	64.3
	2 Placebo	57.7	60.1	53.8	2A Placebo	61.4	61.3	55.0
					2B Lithium	50.1	49.3	53.6

Phase 1, means of 10 subjects; Phase 2, means of 5 subjects. Vertical rearing is expressed as the number of rears in a 5 min period; horizontal activity is expressed as the number of microswitch closures in a 5 min period.

Table II. Horizontal and vertical components of activity in rats given various doses of lithium chloride or phenobarbitone sodium

Drug	Activity component	Drug dosage							
		(meq/kg) 2	4	6	8	10	12	14	16
Lithium chloride	Horizontal	96.7	92.0	104.3	98.1	98.2	93.3	57.2	29.6
	Vertical	107.4	73.3	46.6	49.5	12.7	0.0	0.0	0.0
		mg/kg: 5	10	15	20	25	30	35	40
Phenobarbitone sodium	Horizontal	86.3	85.2	76.4	72.1	27.5	10.6	10.2	5.3
	Vertical	89.5	80.1	63.3	55.7	40.2	6.4	7.7	0.0

Means of 8 subjects. Scores expressed as percentages of saline-treated control subjects' scores. Units of measurement as in Table I.

Table III. The effect on verticalrearing and horizontal locomotory activity of changing environmental stimulation

Activity component	1st stimulus card				2nd stimulus card	
	Colour	5-min period 1	2	3 (test 1)	Colour	5-min period 4 (test 2)
Vertical	Black	39.9	12.2	5.4	Black	5.6
					White	13.8
	White	36.3	26.2	9.7	White	3.1
					Black	19.7
Horizontal	Black	53.3	52.2	55.7	Black	54.4
					White	58.1
	White	64.7	55.5	40.1	White	51.1
					Black	37.3

Subjects tested over 4 sequential 5-min-periods, the stimulus change occurring in the 4th period. Under 1st stimulus card condition: means of 10 subjects; under 2nd stimulus card condition: means of 5 subjects. Analysis in the text performed on 3rd and 4th 5-min-period scores (test 1 and test 2). Units of measurement as in Table I.

Materials and methods. Subjects were 21 100-day-old RCA rats. 8 rats received weekly i.p. injections of lithium chloride in doses of 2, 4, 6, 8, 10, 12, 14, and 16 meq Li/kg, the order of the doses being randomized for each animal: every animal thus experienced each dose level once. A further 8 rats received weekly injections of 5, 10, 15, 20, 25, 30, 35 and 40 mg/kg phenobarbitone sodium, again in randomized sequence. 5 control subjects were given weekly injections of physiological saline. All subjects were tested for 5 min in the activity apparatus, 15 min after being injected. Activity scores were expressed as percentages of average control subject activity on the same day.

Results. Drug effects on activity were dose related (Table II). Under lithium chloride suppression of horizontal activity occurred only with high doses, rearing being suppressed at much lower dose levels. Phenobarbitone sodium, however, suppressed both activity components at approximately the same dose levels.

Conclusions. The dissociation between rearing and locomotion appears to be specific to lithium in these studies and not an artifact of the test situation.

Experiment 3. A third experiment examined the hypothesis that, under the test conditions employed, rearing is a form of exploratory behaviour[3] under environmental control, whilst horizontal activity is relatively independent of stimulus input.

Materials and methods. Subjects were 20 100-day-old RCA rats. 4 sheets of card, 2 white and 2 black, 50 cm², provided environmental stimuli. Each card could be supported vertically at a distance of 45 cm from, and facing, the centre of the apparatus tube. Each animal's activity was monitored over 15 min in the presence of one of the stimulus cards. The card was then replaced by a 2nd card of the same or different colour. Activity recordings were continued for 5 min. 4 combinations of 1st and 2nd card were possible and 5 subjects were randomly allocated to each combination. The score of each subject in the final 5 min in the presence of the 1st card (test 1) was compared with the score for the 5 min with the 2nd card (test 2).

Results. Rearing frequencies decreased rapidly over the 15 min period with the 1st stimulus card; no fall-off appeared in the horizontal activity scores (Table III). Replacement of the 1st card by one of a different colour caused rearing frequency to increase; no increase was observed when the 2nd card was the same colour as the 1st. These findings were reflected in an over-all significant difference between the 2 5-min-scores (test 1 and test 2) ($P < 0.01$) made up of a 1st card × 2nd card interaction ($P < 0.01$) and a 1st card × 2nd card × test interaction ($P < 0.001$). Horizontal activity scores were unaffected by changes in the stimulus card.

General discussion. In experiment 1 lithium chloride reduced rearing frequency in rats under relatively restrictive test conditions; there was, however, no discernible effect upon horizontal locomotory activity. In experiment 2 this differential effect on the two types of activity was shown not to be an artifact of the test situation. Experiment 3 demonstrated that, in the test situation employed, rearing occurred in response to environmental stimuli, whereas locomotory activity did not. Lithium chloride therefore acted to suppress selectively activity which was stimulus controlled. In experiment 1 it was noted that subjects maintained on placebo habituated to the test environment, exhibiting a progressive reduction in rearing frequency over 6 days, whilst subjects transferred to placebo after receiving lithium chloride for 3 days behaved as though they had not previously been exposed to the test situation. There are two possible explanations of the failure of lithium-treated subjects to habituate to environmental stimuli: lithium may impair sensory reception, or it may disrupt central, cortical analysis of sensory information. The former explanation seems unlikely since other workers[4,5] have demonstrated evoked cortical potentials in lithium-treated animals.

Résumé. La chlorure de lithium, administré aux rats, a affaibli leur activité verticale, sans porter atteinte à leur activité horizontale. Ces résultats sont compatibles avec l'hypothèse selon laquelle le lithium affaiblit les réponses des animaux aux stimulations.

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