MULTICHANNEL UNIT FOR RECORDING THE MOTOR ACTIVITY OF SMALL LABORATORY ANIMALS (RATS, MICE)

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In the search for a simple and reliable test for evaluating new pharmacological agents affecting the central nervous system, researchers are turning ever more frequently to various methods of recording the motor activity of small animals [1, 3, 4].

A shortcoming of the methods described in the literature, for example Dews' method [2], is their technical complexity since it is necessary that a large number of recording channels simultaneously operate independently of each other. The method proposed by Knoll [5] is more convenient. Its principle is that an animal moving along a corridor sequentially closes a circuit consisting of metal plates connected (through one) with the ground and with the control grid of an electron tube, which plays the role of an amplifier. Each passage of the animal from plate to plate is accompanied by a single actuation of a pulse counter.

We are proposing an improved variant of Knoll's method. Its advantage is that plates of different size, large for rats and small for mice, are used for recording the motor activity of these animals. It is possible to simultaneously record the individual activity of 20 mice and 10 rats. The length of the plate is selected so that the travel of the animal over a distance equal to its body length is accompanied by a single actuation of the pulse counter.

The entire device consists of two units: a sensor unit and an amplifier-recording unit. The sensor unit is a rack in which are placed measurement cages assembled in six sections (five cages to a section). Four small sections, cages 1-5, 6-10, 11-15, and 16-20, are situated in the upper part of the rack and are intended for mice; the two large sections, cages 21-25 and 26-30, located under them are for rats. On the front wall of each section is a six-pronged plug from which a cable connects with the amplifier-recording unit.

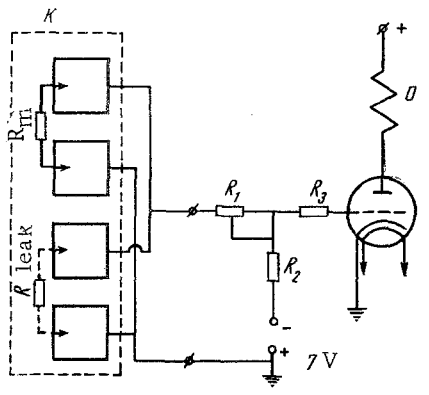

Diagram of the multichannel device for recording the motor activity of small animals. O) Winding of counter; K) measurement cell; resistors: R_1, 820 kΩ; R_2, 6.8 kΩ; R_3, 200 kΩ; R_{leak} and R_m, explanation in text.

The control panel is placed in the upper part of the sensor unit. To ensure cleanliness of the cages, each section has a free-dropping bottom with holes for urine runoff. Under each section there is a pull-out metal pan.

On the face panel of the recording unit there are 30 electromagnetic counters type RS-2-720-003, a tumbler for switching the instrument into the power network, and six tumblers for switching on individual groups (of 5) of measuring circuits (each section of the sensor unit has its own switching tumbler). A signal lamp burns above each switched-on tumbler.

To determine motor activity the animal (mouse or rat) is placed in the sectioned measurement cage on the bottom of which

TABLE 1. Motor Activity of Intact Animals and Its Time Distribution

Recording period (in min)	Motor activity (average number of runs)		Recording period (in min)	Motor activity (average number of runs)	
	abs.	%		abs.	%
Mice (n^1 = 240)			Rats (n = 100)		
60	445 ± 15	100	180	88 ± 5	100
Including by intervals:			Including by intervals:		
0-15	184	41	0-60	64	72
16-30	101	23	61-120	14	16
31-45	85	19	121-180	10	12
46-60	75	17			

*n-number of observations.

TABLE 2. Effect of Phenamine and Aminazin on the Motor Activity of White Mice

Preparation and dose (in mg/kg)	Number of animal	Mean value of motor activity (M ± m)	Relative shift of activity
Control	240	445 ± 15	1.0
Phenamine:			
2.5	40	581 ± 92	1.3
5	40	1045 ± 127	2.35
10	40	2281 ± 201	5.1
Aminazin:			
1	40	317 ± 32	0.71
2	40	130 ± 19	0.29
4	40	43 ± 6	0.097

are attached the metal plates a short distance from each other. The plates of a section are connected (by one) into two groups, each of which is connected to the circuit (see figure), where one half of the 6N5P tube, into whose plate circuit is switched the winding of the electromagnetic counter, is used. Under ordinary conditions the tube is closed by a negative voltage (of the order of 7 V) supplied to its grid through resistors R_2 and R_3.

The animal placed in the cage closes two adjacent plates by the resistance of its own body (resistor R_m). Since a current will flow through resistors R_2, R_1, and R_m, the voltage across the tube grid will drop almost to zero (owing to the voltage drop across the large resistance R_2), the tube is opened, and a current passes through the winding of the electromagnetic counter. Moving about the cage, the animal by the resistance of its own body, causes opening and closing of two adjacent plates, and in the plate circuit of the tube appear current pulses which are recorded by the counter.

It can be that the leakage resistance markedly drops as a result of contamination of the space between adjacent plates of the cage (R_{leak}). The circuit will not operate in this case but only when the animal moves from plate to plate (i.e., upon closing of the plates by the resistance of the animal, the magnitude of which is about 100 kilohms) because a variable resistor R_1 was added to the circuit.

Since counters not having a zero setting were used in the circuit, the experimental data were calculated by determining the difference between the final readings of the counter and the number recorded before starting the experiment. This operation can be facilitated if, before starting work, the initial readings of the counter are rounded off by means of the push-button on the test panel. The test panel has a plug for connection with the recording unit, to which it can be hooked in place of one of the sections of the sensor unit. On the panel are a 5-position switch (for the number of channels in each section) and a button, pushing of which imitates closing of two adjacent plates of the sensor through resistor R_m, which corresponds to a single passage of an animal from one plate to another and leads to actuation of the corresponding counter. The instrument is supplied from a 220-V network.

Animals placed for the first time into the unfamiliar situation of the counting chamber demonstrated a distinct orienting reaction which was manifested by increased motor activity during the initial recording period. At later time intervals there was a noticeable drop of activity, especially for the rats. The appropriate data are given in Table 1 where the time distribution of motor activity of mice (recording was carried our for 1 h; the results were read every 15 min) and of rats (3-h recording period, data obtained every hour) is shown. It follows from Table 1 that the "peak" of orienting activity for animals of both species was at the starting period of the experiment.

Following the orienting "peak" we observed a gradual lessening of motor activity which then became established at a relatively constant (low) level.

The motor activity of small animals is extremely convenient for a comparative assay of the action of drugs exciting or inhibiting the central nervous system.

The results of the experiments on the effect of phenamine and aminazin in increasing doses on the motor activity of white mice are summarized in Table 2. Phenamine injected intraperitoneally in a dose of 2.5 mg/kg 15 min before the experiment evoked a noticeable increase of motor activity. An increase of the phenamine dose to 5 mg/kg and then to 10 mg/kg led to an appreciable enhancement of the exciting effect.

Aminazin, as follows from Table 2, in doses of 1, 2, and 4 mg/kg led to a lessening of motor activity as the dose of the preparation was increased.

The use of this method makes it possible to investigate a large number of animals; the results of the measurements of motor activity are easily analyzed statistically. The method is simple in handling and reliable in operation. All this affords great opportunities for its use under conditions of mass pharmacological experiments to assay new drugs.

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