The absorptive properties of the lung, which have not been adequately realized, are physiologically important because they conserve solutes that have escaped into the air spaces. On the other hand, these absorptive properties permit the introduction of antigenic substances into the general circulation, and thus may set the stage for allergic reactions not only in the lung but in the body as a whole.

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Barometric Pressure Fluctuations: Effects on the Activity of Laboratory Mice

Abstract. *Fluctuations in naturally occurring levels of barometric pressure appear to be an important determinant of activity in laboratory mice. In three experiments, activity was higher after increases in barometric pressure than it was after decreases. When the barometric pressure remained relatively stable, intermediate levels of activity were observed.*

The role of ambient barometric pressure as a determinant of physical and metabolic activity in several plants and in marine invertebrates is a well-documented phenomenon (*1*). A correlation between "lunar related barometric pressure cycles" and activity of mice and rats has also been reported (*1*).

These reports indicate that barometric pressure may be an important determinant of the activity of mice in a variety of situations commonly used in studies of behavior. In order to investigate this possibility, two ongoing experiments were analyzed for an effect by barometric pressure, and a third experiment was set up to investigate the phenomenon directly. In all three experiments the mice were housed in a colony room (21.5 m^2) with a 12-hour light cycle (14 fluorescent lights, 40 watts each, on from 6 a.m. to 6 p.m.) and constant temperature (22°C maintained by steam heat in winter, air-conditioning in summer). Humidity and partial pressure of oxygen (pO_2) levels were not measured or controlled. A Taylor recording barometer was used to provide a constant monitor of barometric pressure.

In experiment 1 operant behavior scores of four male mice, strain C57BL/6J, were analyzed for an effect by barometric pressure. These mice had been run for 14 months in an operant conditioning chamber built for mice. Each mouse spent 1½ hours per day in the chamber, where it licked a small tube to receive a reward of sweetened condensed milk. Light [two 7-watt fluorescent lamps illuminating a soundproof box (0.61 by 1.22 m) in which the chambers were housed], temperature (24°C), and time of day were held constant. In analyzing the data, daily sessions were divided into three groups on the basis of a comparison of the level of barometric pressure during each session with the level during the session which preceded it by 24 hours. Results of this analysis are shown in part 1 of Fig. 1. The group means were compared by using two-tailed Student's *t*-tests. The mean number of responses per minute during sessions after rising barometric pressure [+0.1 inch (0.02 mm) of Hg or more during the 24 hours immediately preceding a session] differed significantly from the mean number of responses per minute during sessions after falling (− 0.1 inch of Hg or more) barometric pressure ($P < 0.05$). No significant correlations between activity scores and absolute levels of barometric pressure were observed.

In experiment 2, scores for wheel-running activity were analyzed in three groups of male mice (RX-GE, DX-GE, and DX-ML) (*2*). Data were analyzed in the same way as they were in experiment 1 in order to discover whether the same relation between changes in barometric pressure and activity obtained in this situation. Data from the three groups were combined, which resulted in a subject pool of 137 animals. The mice in this experiment were maintained, for 2 weeks before the start of the experiment, in the same colony room and under the same conditions as mice in experiment 1 were. Five mice were placed in individual activity wheels at 1 p.m. each day. They remained in the wheels for 23½ hours under conditions of constant illumination [two 7-watt fluorescent lamps illuminating a soundproof chamber (0.61 by 1.22 m) in which the wheels were housed] and constant temperature (24°C). Each mouse was run

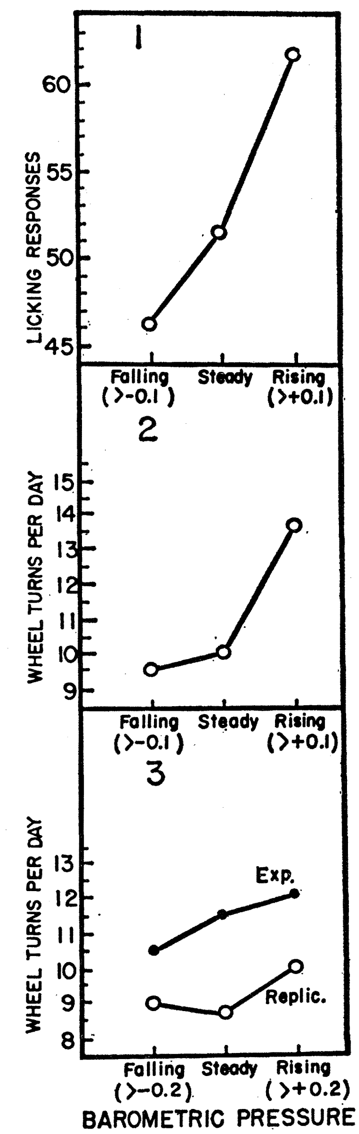

Fig. 1. Mean activity scores of laboratory mice as a function of changes in ambient barometric pressure in three experiments that correspond to parts 1, 2, and 3. Changes in barometric pressure are expressed in inches of Hg. For parts 2 and 3, the numbers on the ordinate must be multiplied by 10^3. (See text for rates of changes in barometric pressure.)

for only one 23½-hour session, and the total number of wheel-turns for each mouse during this period was used as the measure of activity for that mouse. These activity scores were again divided into three groups (rising, steady, and falling) on the basis of the level of barometric pressure. Results of this experiment are summarized in Fig. 1, part 2. A comparison of the group means by use of one-tailed Student's *t*-tests revealed that the mean number of wheel-turns for the sessions after rising barometric pressure was significantly higher than the mean number during sessions after periods of relatively steady barometric pressure ($P < 0.005$), and also significantly higher than the mean number during sessions after falling barometric pressure ($P < 0.05$).

After observing the effects of barometric pressure on behavior in two ongoing experiments, a third experiment was set up to provide a direct test of these effects under conditions that should not suppress circadian rhythms. In the third experiment ten male hybrid mice (F_1 of reciprocal crosses between C57BL/6J × DBA/2J) were placed in individual activity wheels for 34 days. The animals were given continuous access to food and water, continuous light (chamber and illumination were similar to those used in experiment 2), and a constant temperature of 24°C.

A slightly different procedure was used for analyzing the data in this experiment. Once again the mean number of wheel-turns per day was used to assess activity. Under the conditions of this experiment almost all of the activity observed occurred in relatively short (3- to 4-hour) bursts of continuous running. Further, since the average cycle was approximately 26 hours, these activity bursts did not occur at the same time each day. Figure 2, which includes the daily records of one of the mice for the 24-day period, clearly shows the activity bursts and the shift in daily cycle. Under these conditions, periodicity was obviously the major determinant of activity, and the method of analysis used in the first two experiments did not yield any significant effects of barometric pressure when applied to this experiment. However, the fact that changes in barometric pressure did have an effect in this experiment (see Fig. 1, part 3) was shown by using levels of barometric pressure

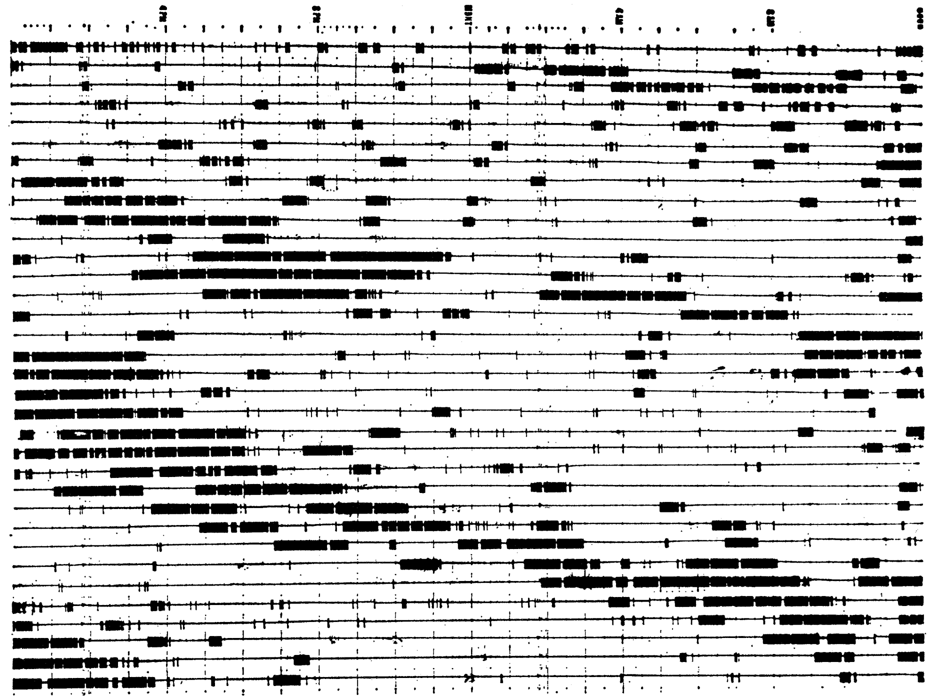

Fig. 2. Daily activity records from a representative subject in experiment 3. Each record begins at noon and ends at noon the following day, and the records are arranged serially from day 1 at the top to day 34 at the bottom of the figure.

during the activity bursts (defined as 2 or more hours of continuous running) for comparison rather than the levels during the entire 24-hour period (except in the few instances when activity occurred throughout the 24-hour period, in which case levels of barometric pressure for the entire period were also used). Since experimental conditions in experiments 1 and 2 probably elicited bursts of activity, this method of analysis was probably the most appropriate experimental comparison as well. That is, bursts of activity were compared in all three experiments. A comparision of the group means (one-tailed Student's *t*-tests) revealed that the mean number of wheel-turns after rising barometric pressure (+0.2 inch of Hg or more) was significantly higher than the mean number of wheel-turns after falling (−0.2 inch of Hg or more) barometric pressure ($P < 0.005$). A stricter criterion for a rise or fall in barometric pressure (+0.2 or −0.2 inch of Hg) was used because the experiment was conducted in November and December when large and rapid changes in barometric pressure occur quite frequently in this area.

In a replication of this experiment, in which ten different male hybrid mice (same hybrid) were used, quite similar results were obtained (see Fig. 1, part 3). A comparison of the group means (one-tailed Student's *t*-tests) revealed that activity scores after rising barometric pressure were significantly higher than the scores following periods of relatively steady barometric pressure ($P < 0.01$), and were also significantly higher than activity scores after falling barometric pressure ($P < 0.05$).

These experiments do not rule out the possibility that some factor that is strongly associated with barometric pressure (for example, humidity or pO_2) could be responsible for the observed results. However, Brown's investigations (*1*), which in some cases did control these factors, suggest that while factors related to barometric pressure do have effects, these effects are generally not as large as those produced by barometric pressure.

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