

AUGMENTATION OF ACTIVITY IN THE SLOTH BY ADRENAL
EXTRACT, EMOTION AND OTHER CONDITIONS

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The sloth is an excellent subject for testing the excitatory effect of certain substances or conditions. Its basal level of activity is very low and increments can be readily observed. In a short while one may train the animal to travel a horizontal pole, and this it will do under ordinary laboratory conditions repeatedly and at a fairly uniform rate. The sloth is also fairly easily handled, and in the American tropics a plentiful supply may be secured.

In the course of other work observations were made on activity in two species of sloths, the two-toed *Choloepus hoffmanni* and the three-toed *Bradypus griseus*.² Cortico-adrenal extract, adrenalin, prostigmin and other substances were tested for their action, and the effects of emotional excitement and increases in body temperature were also noted. The tests followed a chance observation that sloths moving into the sunshine become very active as they warm up. When kept in the sun for two to four hours, however, they develop convulsive seizures and die.

A sapling tree about 15 feet long and 4 inches in diameter, suspended horizontally, served as a testing "course." At one end of this the sloth was placed in its normal upside-down position, and usually it set out immediately toward the other end. There the animal was turned face-about by an attendant, and it then retraced its steps at the same steady gait. From 8 to 12 normal "runs," constituting a series, were thus made before each experiment. Timing was done by stop-watch over a marked 12-foot length of the course.

Emotional excitement was readily set up in the sloth, as noted in an earlier paper (Britton and Kline, 1939) by making sham thrusts and sallies by hand or a whisk broom toward the animal, placed on its back in the grass, for three minutes. Exposure to the sun was made for 1 to 2

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hours; this usually raised the body temperature 3° to 5° above normal. Cortico-adrenal extract was found most effective in doses of 5 to 10 cc. every 2 or 3 hours; adrenalin and prostigmin were used in suitable small doses, sometimes repeated. From two to four series of tests of activity were carried out at intervals after treatment.

The results were almost invariably well defined. Typical and illustrative of the experiments are the following protocols:

March 1, 1938. Barro Colorado Island Laboratory, C.Z.

Two-toed sloth, no. 5, normal.

Excitement test. 10 a.m., walking on pole, 12 ft. course; running time, seconds per 12 ft. run, 24, 18, 18, 19, 20, 18, 21, 24, 24, 22; average, 20.8. Put animal on ground, excited by handling, etc., for 3 min. Time after excitement, seconds 16, 16, 13, 14, 13, 12, 10, 10, 14, 14; average 13.2.

Increased rate after excitement, 38 per cent.

March 4, 1938. Barro Colorado Island Laboratory, C.Z.

Two-toed sloth, no. 13, normal.

Temperature test. 12 m., rectal temp. 34.0° ; walking on pole 12 ft. course; time, seconds per 12 ft. run, 28, 26, 28, 32, 30, 26, 28, 30, 30; average 28.7. Warmed in sun in cage, 1 hour; rectal temp. at 1:30 p.m., 36.1° ; running times, seconds, 20, 18, 18, 17, 18, 17, 18, 19, 20, 18; average 18.3. Later runs averaged 20 sec. per 12 feet.

Increased in running rate after warming, 37 per cent.

March 28, 1939. Gorgas Memorial Laboratory, Rep. Pan.

Three-toed sloth, no. 10, normal.

Test, effect of cortico-adrenal extract. 2:15 p.m., walking on pole, 12 foot; time, seconds per 12 foot, 25, 26, 28, 25, 26, 28, 26, 30, 32, 32; average 27.8. Gave 5 cc. cortico-adrenal extract s.c. at 2:25 p.m., 5 cc. at 3:15 p.m. Times of runs, 4:30 p.m., 18, 18, 16, 18, 20, 20, 19, 20, 20, 20; average, 18.9. Further doses of extract given; running time, average 19 sec.

Increase in rate after extract, 31 per cent.

The increase in activity brought about by raising the body temperature, on exposing sloths to the sun, was somewhat greater than under any of the other conditions studied. In 5 of these cases, the rises in rate of running were over 100 per cent above normal. In 17 series of runs, considering both species of sloths, the average rise was 45 per cent (table 1).

The larger increases in activity were usually associated with greater rises in body temperature. In the series of two-toed sloths exposed to the sun for 1 to 2 hours, the body temperature rose from an average of 33.4° to 36.8° (8 cases); in three-toed sloths, from 32.0° to 36.4° (9 cases). In other experiments there were observed rises in rectal temperature usually within 1° , except after prostigmin injection in which case increases up to 2° occurred. The temperature increments in sloths on emotional excitation have already been noted (Britton and Kline, 1939).

There was no significant difference in increases in activity under other conditions studied, in which they approximated 30 per cent. On the

two-toed sloth, however, cortico-adrenal extract did not appear so effective, there being an 18 per cent increase only compared to 32 per cent in the three-toed form.

The greatest effect of emotional excitement was shown immediately after excitation. Adrenalin and prostigmin effects were optimum within 20 to 40 minutes, and cortico-adrenal extract in 2 to 4 hours. In several cases the beneficial action of the adrenal hormone was maintained for 8 to 12 hours. Prostigmin appeared to act somewhat like emotional excitation, and often brought out a strong fighting reaction in the sloth, especially the 2-toed species.

TABLE 1

Increase in activity of sloths under different conditions

(Tests of animals walking up side down on under surface of horizontal 12-foot pole. Each series was made up of 8 to 12 individual "runs." See text.)

| ANIMAL | EXPERIMENTAL SERIES | NUMBER OF SERIES OF RUNS | NORMAL RATE | EXPERIMENTAL RATE | INCREASE IN RATE AVERAGE PER CENT |
|------------------|--------------------------------------|--------------------------|----------------------|-------------------|-----------------------------------|
| | | | Av., sec. per 12 ft. | | |
| Two-toed sloth | 1. Cortico-adrenal extract injection | 6 | 23 | 10 | 18 |
| | 2. Adrenalin injection | 9 | 23 | 15 | 33 |
| | 3. Prostigmin injection | 11 | 35 | 27 | 24 |
| | 4. Emotional excitement | 9 | 25 | 16 | 35 |
| | 5. Exposure to sun (warming) | 8 | 29 | 15 | 48 |
| Three-toed sloth | 1. Cortico-adrenal extract injection | 4 | 31 | 21 | 32 |
| | 2. Adrenalin injection | 8 | 36 | 26 | 27 |
| | 3. Prostigmin injection | 7 | 34 | 21 | 38 |
| | 4. Emotional excitement | 15 | 39 | 28 | 29 |
| | 5. Exposure to sun (warming) | 9 | 37 | 21 | 42 |

Several other substances were tested for their possible influence on sloth activity—thyroxin and thyroid extract, pituitary extract, benzedrine sulphate and strychnine sulphate. All were without significant effect, however, on the rate of progress of the sloth under the given conditions. Observations after the injection of thyroid preparations were made over a period of three days.

It appeared from over 900 individual tests that the two-toed sloth travels on an average 1 mile in 3 hours, and the three-toed species 1 mile in 4½ hours. Many animals nevertheless take 6 or 7 hours to cover the distance. The rate of progress in the wild is probably much slower. On excitation in the laboratory a mile an hour may be covered by the two-toed sloth, and a mile in 2 hours by the three-toed species. Some years ago the increase in activity brought about by cortico-adrenal extract was

observed in this laboratory (Eagle, Britton and Kline, 1932), and numerous workers have since reported confirmatory results.

SUMMARY

In several hundred tests the sloth was observed to progress on the average at the rate of 1 mile in 3 or 4 hours. Under excitation its speed was increased by 25 to 50 per cent, or in some cases more than 100 per cent. Both two-toed and three-toed species were used; the latter were the slower animals.

Emotional excitement, and raising the body temperature of the sloth, were very effective stimulants to increased rate of movement.

Cortico-adrenal extract, adrenalin and prostigmin also markedly increased bodily activity. The beneficial influence of the cortical hormone was maintained for periods up to 12 hours. Several other substances were found ineffective.

REFERENCES

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