Six dogs with complete obstruction of the common bile duct, 5 with ligation of both pancreatic ducts, and 3 with Eck fistulae were studied. Ligation of the pancreatic ducts has been shown by Berg and Zucker[4] to produce fatty degeneration of the liver. For determination of neurotoxic action the sera from these dogs were incubated with rat spinal cord (5 cc. serum with 0.05 gm. cord for 20 hrs. at 37°C.) After 3 days' formalin fixation the spinal cords were imbedded and sections stained for myelin (Weil's method), axis cylinders (Davenport's method) and with cresyl violet. Parallel determinations of lipase were made by the method previously reported.[5]

Normal serum produces only a mild swelling of the nerve fibers in the outer zone of the spinal cord. The serum from Eck fistula dogs was not active on rat cord *in vitro,* but beginning on the fourth or fifth postoperative day sera from animals with ligation of common bile duct or pancreatic ducts produced a severe destruction of both myelin sheaths and axis cylinders. The glia nuclei in the outer zones had lost their staining qualities and the ganglion cells showed marked vacuolation and shadow formation. The abnormal lipase usually appeared in the sera in large amounts within 24 hours after the operation, and had usually reached its peak before neurotoxic activity appeared. The lipase usually disappeared about a month after duct ligation but at this time the neurotoxic activity was still strongly present. Further, it was found that serum heated to 62°C. for 30 minutes lost all lipolytic action but the neurotoxic agent was unaffected.

We conclude that in experimental hepatic damage a neurotoxic agent is present in the blood serum, and that this activity cannot be accounted for by the lipase which is often simultaneously present.

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New Methods for Studying Motility During Sleep.

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The methods heretofore employed for investigating motility during sleep involved the continuous recording on a kymograph of the

[4] Berg, B. N., and Zucker, T. F., PROC. SOC. EXP. BIOL. AND MED., 1931, **29**, 68.

[5] Crandall, L. A., Jr., and Cherry, I. S., PROC. SOC. EXP. BIOL. AND MED., 1931, **28**, 570.

position of the bed-spring or the whole bed, by direct transmission to a writing lever, pneumatic transmission to a recording tambour, or electrical transmission to a signal magnet. The first 2 of these methods furnish a record of the frequency as well as of the magnitude of movement, the last one, only of frequency.

Although it has been shown repeatedly that one stirs and turns over several times per hour during sleep, it has never been determined how much *time* one spends in these movements, or by difference what part of the time given to sleep one really lies still. One of the new methods was developed to answer this question. A large tambour (one foot in diameter) was placed under the bed and connected to the bed-spring by means of a vertical rod. The tambour was supplied with inlet and outlet valves and wired in such a manner that the opening of either valve would break an electric circuit. When the sleeper moved the displacement of the bed-spring downward compressed the air in the tambour causing the outlet valve to open, and the displacement of the bed-spring upward rarified the air causing the inlet valve to open. The valves remained open, and the circuit broken during the entire movement. Through a relay in the circuit a Telechron electric clock was started and kept running during the movement, or else a clock that was running stopped and kept still. With 2 clocks both of these effects could be produced simultaneously. The first clock having been set at zero (12 o'clock) before going to bed, its reading next morning gives the time spent in movement during the night. The same result could be obtained by noting how much time the second clock lost in the same period of time. The inertia of the clock motor did not permit it to respond instantaneously to the make and break of the electric circuit, so that the first clock gave a reading that was too high and the second clock a reading that was too low. It was necessary to calibrate the clocks by recording repeated movements of the bed-spring, of longer and shorter duration, by means of a signal magnet on a very rapidly moving kymograph and comparing the time actually spent in movement with the readings of the clock. One clock is sufficient for the determination of the time spent in movement, but by the use of 2 clocks it is possible to obtain additional information concerning the duration of individual movements.

The sleep of 3 persons has been studied. The time spent in movement was very small, varying somewhat in the different subjects, and in the same subject during different nights. Subject C. spent from 34″ to 87″ and an average of 57″ per hour in movement during sleep (based on 12 nights); subject M. from 13″ to 28″ and an

average of 21″ (11 nights); subject K. from 28″ to 79″ and an average of 49″ (16 nights). Concomitant records obtained by the older method showed the motility of all 3 subjects to be within the usual variation as regards frequency of movement. Thus, even though one moves very often, one still lies immovably about 59 minutes out of every hour.

The second method developed is concerned with the sum-total of the displacements of the bed-spring during sleep. A thread attached to the rod connecting the bed-spring with the tambour is fastened at the other end to the lever of a Harvard "work-adder". The wheel of the work-adder can move only in one direction, and the movement of its rim is equal to downward displacement of the bed-spring. The work-adder operates a counter, and by reading the counter it is possible to determine the number of times that the wheel turned around, and thus the sum-total of the displacements of the bed in one direction.

So far 2 subjects were studied by means of the work-adder. The sum-total of the displacements of the bed-spring in the case of subject C. varied from 72.8 to 139.5 cm. (6 nights); for subject M. the figures varied from 43.7 to 97.0 cm. (6 nights). Since the bed-spring returns to the original position, one must double the above figures to obtain the sum-total of all the displacements of the bed-spring.

The methods described are superior to the older ones in that no recording devices and kymograph are needed. The apparatus may be placed under the bed in an ordinary room in a private dwelling that is supplied with a source of alternating current regulated to run electric clocks. The figures for the time spent in movement can be read off directly from the clock and corrected by the factor, and the sum-total of all the movements can be obtained from the readings of the counter attached to the work-adder.

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