show. In view of the composition of the shell of oysters, composed mainly of calcite (rhombohedral $CaCO_3$) and minor amounts of aragonite (orthorhombic $CaCO_3$), it is an interesting question which mineral is in the resilium.

To test its composition, a very small hammer and punch were used to break off small pieces of the resilium of *Crassostrea virginica* (Gmelin) until they made up several cubic centimeters. These pieces were checked under the binocular microscope for adhering fragments of the shell. All such contaminated material was discarded. The pure resilium material was ground to a powder. The x-ray powder diagram made by Dr. J. F. Burst of Shell Development Company shows the curve of the mineral aragonite.

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22 January 1962

Sleep Deprivation, Age, and Exhaustion Time in the Rat

Abstract. Male rats were maintained on a constantly moving wheel in a study of prolonged sleep deprivation. The results obtained revealed a striking negative relationship between age and resistance to exhaustion.

In an earlier study of the effects of prolonged sleep deprivation, six young male hooded rats, 60 days old, were placed on a constantly moving wheel for 27 days. One animal was lost after 17 days. When older animals were tested in a similar manner, it was noted that exhaustion occurred much earlier. This study reports on the relationship of this age variable to exhaustion time.

Six male animals from the following six age groups were obtained from the University of Florida colony: group I, 63 days old; group II, 89 days old; group III, 147 days old; group IV, 170 days old; and group V, 220 days old. At least two litters were represented in each group. The rats were placed, in individual 4½- by 7½-inch cubicles, on wheels, two-thirds submerged in water, which rotated at a constant speed of approximately 2 rev/min. Food trays were placed in each cubicle so that the animals could feed at any time. The rats remained on these wheels continuously except when they were removed for weighing at 24-hour intervals. The total distance covered by an animal during a day was 0.7 mile. The rats, when exhausted, fell from the wheel into the water and were unable to remount the wheel. Animals were removed from the experiment when they fell into the water after being replaced on the wheel three times during a 15-minute period.

Figure 1 shows for each age group the time at which the criterion of exhaustion was reached. The group I (63 day) animals were removed after 9 days although none had reached the exhaustion criterion. It may be recalled, at this point, that 60-day-old rats were run 27 days with the loss of one animal after 17 days. The only difference in the treatment of the 60-day-old rats was that they were kept off the wheel for a longer time (approximately 20 minutes) because several additional measures were taken.

The rats' weight loss and their intake of food while on the wheel were measured. The average percentages of weight retention for each of the five groups after 48 hours were as follows: group I, 95.8; group II, 86.2; group III, 89.2; group IV, 90.6; and group V, 93.3. These averages do not include values for one animal from group V and one from group III that did not last 48 hours. These weight losses, however, give a distorted picture in the case of group I, and to some extent in the case of group II, as these animals are still in a growth gain period; thus these figures map represent a considerable suppression of weight gain. There is a .20 correlation (rank order) between amount of weight lost in 48 hours and terminal exhaustion time in groups II through V. Finally, the overall weight loss for all animals at the weighing before exhaustion was 15.81 percent.

The average change in food intake from the first day on the wheel to the second day on the wheel was as follows for the five groups (in percent): group I, 248.7; group II, 53.4; group III, 99.1; group IV, 88.8; and group V, 45.3. These figures represent the total food intake during the second day divided by the total food intake during the first day in percentage terms. The correlation between the change in food intake and the change in exhaustion time was not significant.

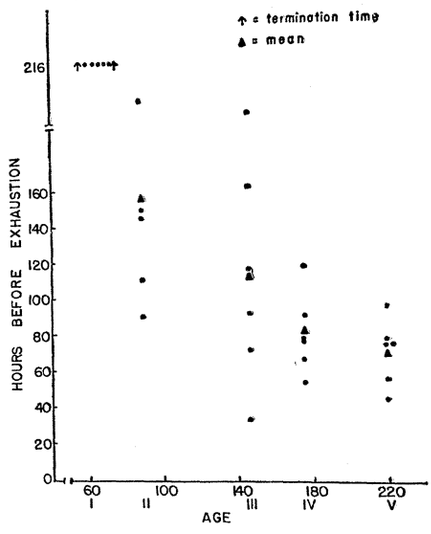

Fig. 1. Exhaustion times of each rat and group means as a function of age. Note that, in group I (age 63 days), runs were terminated after 216 hours.

In conclusion, the data show a clear-cut relationship between exhaustion time and age. Because the amount of activity involved is far below the normal free-run activity of a rat and because the weight loss before exhaustion is certainly within survival limits, it is at least plausible to hypothesize that this exhaustion is related to sleep deprivation (*1*).

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Arrangement of DNA in Living Sperm: A Biophysical Analysis

Abstract. The submicroscopic arrangement of DNA molecules in living sperm is analyzed by new, highly sensitive polarization optical techniques. It is concluded that the molecules are arranged as a coil of a coil in sperm chromosomes, which in turn appear to be arranged in single file with a definite sequence.

Despite major advances in our knowledge of the molecular structure of DNA (deoxyribonucleic acid) (*1*, *2*) and its genetic significance, little is yet known of the exact arrangement of this molecule in chromosomes of living cells. We have inquired into this problem by developing a new method of fine structure analysis which takes advantage of