large dose of a diuretic could completely block reabsorption in that segment of tubule on which it acts. According to them, the proximal segment, in which water and electrolytes are reabsorbed as an isosmotic solution, is responsible for two-thirds or more of the total renal reabsorptive capacity for water and sodium. Their observation that large doses of mercurial diuretics block about 20% of the reabsorptive capacity led them to assume that mercurials act on the distal segment. In the distal segment of the tubule, water must be reabsorbed against an osmotic gradient, a process that requires energy. Succinic dehydrogenase, involved in the citric acid cycle of Krebs, probably participates in formation of this energy.

Our results support the view that mercurial diuretics act on the distal segment of the tubule because the activity of succinic dehydrogenase, after the administration of the mercurial, first disappeared from the region of the distal tubule, in which the concentrative reabsorption of water begins. In the distal convoluted tubules, however, such a complete inhibition could not be observed.

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Observations on the Daily Movements of Fishes[1]

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Earlier work in this laboratory (*1, 2*) described a pre-sundown movement of schools of perch (*Perca flavescens*) from 25–35-ft depths, where they hover in the daylight hours, onto a 18- to 30-ft shelf adjacent to Second Point in Lake Mendota. At sunrise the movement is reversed.

This study was made with an echo-sounding unit in a 40-ft Navy launch that records sound pulses returning from the bottom of the lake and from intervening schools of fish (*3, 4*). An oscilloscope attachment was built into both the transmitting and receiving circuits of a U.S. Navy pattern NJ-9 echo sounder to permit the keying of the sound transmission by the blanking pulse to characterize the echo by a scope-tube trace. The circuit was changed to obtain unsaturated d-c (Fig. 1) and a-c (not illustrated) signals that are proportional to the strength of echo. The oscilloscope permits any part of the trace to be isolated and magnified for more detailed study. In depths less than 10 ft, where the reverberations from the outgoing transmissions tend to blend with and obscure the echo, the amplifier gain can be adjusted so that only the echo will be accepted. Searches, therefore, at depths of 5–10 ft can be made. Details of the circuit will be published elsewhere.

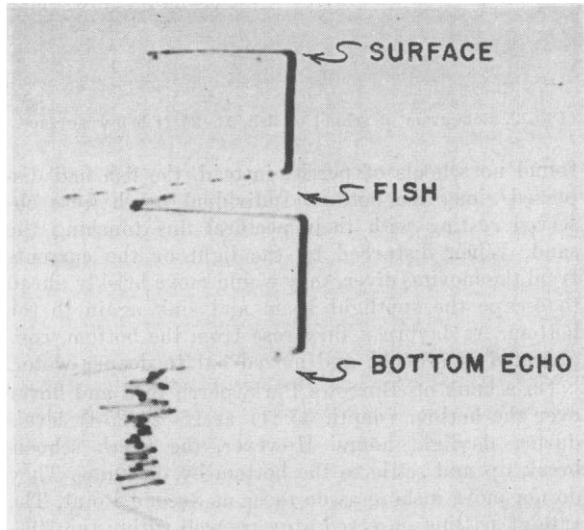

Fig. 1. Echo trace of saturated d-c signal of oscilloscope showing fish midway between surface and bottom.

It was seen on the oscilloscope screen that the schools of perch moved onto the Second Point shelf high over the bottom during their pre-sundown, inshore movement and reached their greatest concentration during the hour before sunset. They settled lower as twilight approached and their echo trace blended finally into the bottom echo. No further evidence of their presence was discernible on the instruments after darkness set in.

A diver, equipped with an aqualung and communicating with the boat via throat microphones, descended to the bottom at intervals during the pre- and post-sundown period. This was repeated on eight different evenings in July and August, 1952. The divers used spotlights for observations after dark.

Pre-sundown observations revealed the perch, 6–11 in. in length, aggregated in tight schools with 8–10 in. between individuals. As long as there was sufficient light for the diver to see without artificial light, the fish moved in schools off the bottom. Figure 1 shows the oscilloscope echo from the fish.

After sundown the divers, aided by spotlights,

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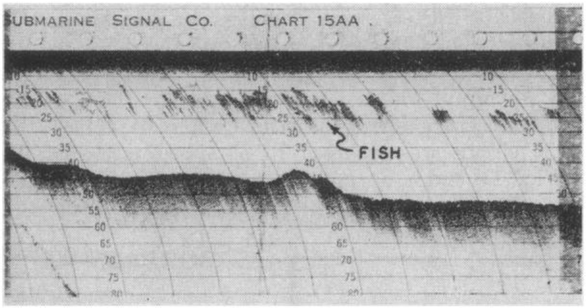

FIG. 2. Echogram of school of fish, 15–25 ft below surface.

found no schools of perch; instead, the fish had dispersed along the bottom. Individual perch were observed resting with their pectoral fins touching the sand. When disturbed by the light or the currents from the moving diver, they would move briskly ahead to escape the spotlight beam and sink again to the bottom. At daybreak they rose from the bottom, congregated in schools, and moved out to deeper water.

On a bank off Burrows Park, perch feed and hover over the bottom (depth 35 ft) at 15- to 25-ft levels during daylight hours. However, the perch schools break up and settle to the bottom by darkness. They do not move inshore as do those at Second Point. The rate of settling observed appears well within the 30% change in pressure to which a physoclist fish, such as perch, can adapt (*5*), over a 2–3-hr period.

Previously, we had assumed, on the basis of sporadic gillnet sets, that in daytime perch hovered as deep as 45 ft in summer. Our midday echograms record the great majority at 25–35 ft (Fig. 2). Therefore, the movement toward shore requires very little change in depth—chiefly a horizontal movement with only minor vertical changes. Midday echo-sounder records during July revealed heavy concentrations of fish in the areas off Second Point.

Among aquarists, a "sleep" of fishes is commonly observed. This fact was reported as early as 1874 (*6, 7*). Also, perch have been observed on the bottom of an aquarium at night (*8*).

TABLE 1

RELATIVE INTENSITIES OF LIGHT, IN FOOT-CANDLES,* AT VARIOUS TIMES AND DEPTHS FOR LAKE MENDOTA ON A TYPICAL JULY DAY

Depth, meters	Hours Before Sunset			
	3	2	1	0
Surface†	2600	2200	1000	100
2	550	460	210	21
4	168	141	64	6
6	50	42	19	1.9
8	15	12	5.7	0.67
10	4	3	1.7	0.17

* To convert foot-candles into lux, or lumens per square meter, multiply values in table by 10.

† Data for surface intensities are based on Madison Weather Bureau records for a typical clear July day; underwater intensities measured with a Weston Photronic Cell.

During summer and early fall, a rapidly changing light intensity obviously sets off the movement, but how it operates and how the fish off Second Point appear to orient toward the southern shallows rather than toward the shore in another direction remains unexplained. Light values are given in Table 1 for various depths in Lake Mendota for a typical clear July day during the migration hours.

It might be postulated that with approaching twilight the perch, accustomed to seeing one another, lose their tendency to school, settle to the bottom, and maintain contact with the sand. Also, it is possible that this nocturnal quiescent behavior could have survival value in escaping natural enemies, many of whom, like the northern pike, hunt for food at night and perceive prey principally by vibrations resulting from the latter's swimming movements. During the day the perch move to open water, an area in Lake Mendota where there is an abundant supply of plankton, their chief food, and where there are few predators.

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A Method for Quantifying the Intensity of Pain[1]

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With the development of pharmacology as it applies to the influence of drugs on sensation, there is a need for demonstrating whether one can in fact deal with the matter of intensity of subjective responses and the modification of intensity by chemical agents. Two aspects of this problem will be dealt with: First, a means for indicating and following the intensity of pain in a group of individuals will be presented. This is an index which permits mathematical validation of difference. Second, the use of the method in comparing the effectiveness of two analgesic agents in the treatment of severe pain will be described. Where agent A and agent B both relieve pain of moderate degree equally well, there is still the highly practical problem of determining if one is more effective than the other in relieving severe pain.

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