30 minutes until sweating was pronounced.

In the emotional sweating trials both atropine and dibenzyline were alternately introduced into the palms. The iodine-starch technique was applied to the areas treated. The patient was put in an air-conditioned, cool room for 30 minutes as a control period to be sure that no thermoregulatory sweating took place. A painful stimulus was then applied, either by performing a clumsy venipuncture or manipulating a body part until obvious pain and sweating was produced.

The following observations resulted from the above trials: Well delineated sweat patterns were observed on the areas tested after overheating and after stress. In all instances, both thermoregulatory and emotional sweating were blocked by the local introduction of atropine into the skin. In no instance was either thermoregulatory or emotional sweating inhibited by the local introduction of dibenzyline into the skin.

The sweat glands are anatomically under control of the sympathetic nervous system, but their function is modified by drugs which act on parasympathetically innervated effector cells. This was clarified by Dale and Feldberg (*4*) in 1934 when it was discovered that nerve impulses which cause sweating release acetylcholine at the neuroglandular junction. Although the nerve fibers involved traverse sympathetic pathways, they are functionally analagous to parasympathetic nerves. In man, most sweat glands are probably innervated by fibers which function via acetylcholine as the mediator, but there is indirect evidence that the sweat glands in certain areas may be supplied by fibers which release the sympathetic mediator at the periphery (*5*). Haimovici (*6*), in 1950, pointed out that sweating in man can be elicited by adrenergic agents and can be inhibited by an adrenergic blocking agent. He concluded that in addition to the known cholinergic fiber supplying the sweat glands, there is also an adrenergic component in the nervous mechanism of sweating in man.

Accordingly, there can be little doubt that there is both cholinergic and adrenergic response of the sweat glands under certain circumstances, but under the conditions existing during my experiments it seems that both thermoregulatory and emotional sweating remains under cholinergic control. There may be a quantitative difference in the type and amount of sweating, depending on the emotional state of the individual. Perhaps during a prolonged emotional stress period the adrenergic mechanism becomes more prominent, and this may account for the clinical observation that adrenergic blocking agents will control sweating to some degree (*6*).

Dibenzyline is thought to act as a blockade to one of the steps in the process of excitation by adrenergic agents. This blockade is interposed between the penetration of the cells of the effector organ by norepinephrine and secretion of the effector organ. If adrenergic sweating does in fact exist, perhaps the site of action or the mechanism of excitation at the effector organ is not as previously thought. Perhaps the site of action of systemic dibenzyline is different than that produced by local iontophoresis. More definitive work is necessary to further clarify this mechanism.

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4 February 1960

Movement of Radiosodium in a Chemically Stratified Lake

Abstract. The rapid horizontal dispersal of sodium-24 at an average rate of about 18 m/day has been observed near the bottom of a small thermally and chemically stratified lake. However, no appreciable vertical movement of the radioactivity was observed during a period of 6 days.

The discovery of a meromictic lake (Stewart's Dark Lake) in northwestern Wisconsin (T.33N., R.9W.) has provided us with the opportunity to study the limnological characteristics of meromixis. Moreover, we envisaged the use of this lake for pilot studies in aquatic science pertaining especially to problems of radioactive waste disposal.

Meromixis occurs in a lake in which the dissolved substances create a gradient of density differences, in depth, preventing complete mixing or circulation.

This type of lake is normally stratified in three arbitrary zones. The upper, freely circulating layer of water is termed the mixolimnion (*1*). The bottom, relatively very dense, noncirculating stratum is the monimolimnion (*2*) and the transition zone between, the chemocline.

Most temperate-zone lakes are stratified throughout the summer and winter because of density differences owing to a temperature gradient. However, during the spring and autumn when temperatures become homoiothermal from top to bottom, relatively low wind velocities can cause these lakes to "turn over" or circulate completely. Meromictic lakes may have a thermal stratification superimposed upon the chemical stratification. Nevertheless, it is the solute concentration that maintains the stability which persists from year to year, thereby inhibiting the intermingling of the monimolimnetic waters with the above water.

Stewart's Dark Lake is a bog lake with an area of approximately 2 acres. The maximum depth is 8.8 m, the average depth 4.3 m. The lake is maintained by seepage, for there is no inlet or outlet. Colloidal (humic) materials arise from decaying vegetation and "stain" the water a dark brown. The lake represents a highly restrictive habitat for organisms because the monimolimnion never contains measurable amounts of dissolved oxygen. This condition becomes extreme during the winter when the entire lake is characterized by the absence of dissolved oxygen for 2 months or more. In addition, the lower strata contain relatively high concentrations of sulfides.

From the limnological data obtained on the meromictic nature of this lake during the past 2 years, it was observed that under optimum conditions for "overturn," complete circulation extended only to the 6-m level. Thus the monimolimnion, by definition, exists continuously in at least the bottom 2.5 m of the lake. This represents 12.7 percent of the total volume of the lake. Carbonate levels as high as 96 mg/liter persist in the deep water as compared with a concentration of 5 mg/liter at the surface.

In order to obtain information concerning the extent to which this supposedly "stagnant" zone is isolated from the remainder of the lake, we used a radioactive tracer. On 1 July 1959 approximately 47 mc of sodium-24 in the form of NaCl in HCl solution were released within the lake at the 8-m level by smashing an 800-ml museum jar containing the radioactive solution.

Sampling was done along six transect lines radiating from above the release point. These were lines of polyethylene "floating" rope which spanned the lake.

A 2-inch sodium iodide crystal scintillation detector, enclosed in a watertight

Lucite container, was used. This apparatus was lowered by means of extended cables to various depths and locations within the basin. This method of detection plus the Na^{24} was used in an attempt to alleviate some of the sampling difficulties alluded to by other workers (*3*).

Figure 1 is an outline map of Stewart's Dark Lake showing the approximate extent of horizontal movement of the Na^{24}. The radioactivity was dispersed horizontally from the release point in a somewhat symmetrical pattern and was observed to have reached an average distance of 18 ± 3 m in all directions at the end of the first 24 hours. In one direction, a maximum horizontal movement of 22 m was observed during this period. This is a rate of horizontal movement, in this relatively static zone, which is several times greater than that found by other workers in similarly stable lake strata (*3*, *4*).

The radioactive material flowed along the bottom contour and continued to move toward the shore, reaching an average distance of 24 ± 3 m from the release point in 48 hours. Owing to the rapid decay of the Na^{24} and its dilution within the lake, however, accurate determination of the movement after the first day was difficult and became impossible by the third day. In addition, the background emanating from the bottom muds was highest near the shore, further hindering the accurate determination of the leading edge of the radioactivity.

Careful observations were made to determine whether the radioactivity was transported vertically within the lake. No appreciable vertical movement was observed above the release point, except shortly after the discharge, when high concentrations were found at the 4- and 6-m levels. This initial upward movement may have resulted from a density difference between the radioactive solution and the lake water at the release position. Also, a few small bubbles were seen to come to the surface as the bottle was broken, thus possibly transporting some radiosodium to higher levels. Further upward movement of the radioactivity, after this initial movement, was not observed above the release point. In addition, no vertical movement of the radioactive material was found at any other location in the lake.

The radioactivity was detectable in the lake for only 6 days, a fact which minimized any possible problems of radiation hazard to wildlife and other aquatic organisms.

There are at least two possible explanations for the rapid horizontal movement of the radiosodium; (i) physical transport as influenced by eddy diffusion, currents, internal seiches, and (ii) biological transport of the radionuclide to other parts of the lake (*5*).

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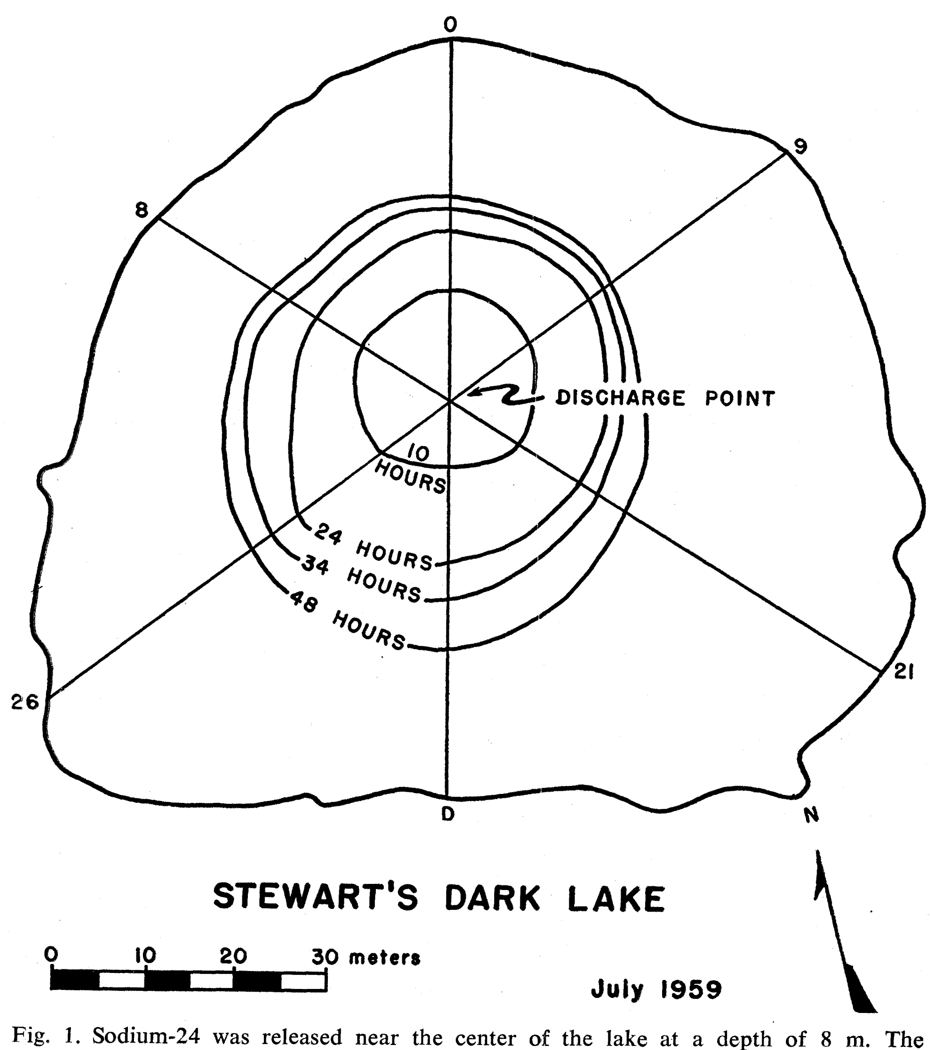

Fig. 1. Sodium-24 was released near the center of the lake at a depth of 8 m. The outlines mark the approximate horizontal movement of the radioactive material.

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Continuity of Mid-Oceanic Ridge and Rift Valley in the Southwestern Indian Ocean Confirmed

Abstract. The existence of a continuous, rifted, mid-oceanic ridge in the southwestern Indian Ocean, previously predicted by us, has been confirmed by soundings taken by the research vessel *Vema* during the expedition now in progress.

An important objective of the present world cruise of the *Vema* (*Vema* cruise No. 16, 1 October 1959 to 1 August 1960) is the examination of the Mid-Oceanic Ridge. The outstanding questions are (i) whether the ridge is continuous, as has been inferred from topographic and seismicity data (*1*, *2*) and (ii) whether the median rift, which has been shown to coincide with the epicenter belt along the Mid-Atlantic Ridge (*3*), follows the epicenter belt along the entire ridge system. The scarcity of soundings in the southern Indian Ocean has made this a critical area for checking the prediction that the mid-oceanic epicenter belt is a guide to the continuation of the median rift valley through unsounded areas.