the U. S. Bureau of Fisheries for several years. In early experiments substances such as copper sulfate were used. Although this substance proved lethal to starfish, several disadvantages attended its use. Because of its great solubility large quantities were needed to create a concentration lethal to starfish, a procedure too expensive to be of practical value. A further disadvantage was the fact that many marine organisms besides starfish were killed by the chemical.

Since 1937 experiments on the destruction of starfish by the use of calcium oxide or quicklime have been carried out by the senior author at the Milford Laboratory. The possibility of using calcium oxide for combatting starfish was first suggested by Wood.[2] Recently this substance has been used by the oystermen on grounds located in Long Island Sound.

Under laboratory conditions calcium oxide in powder form proved to be more effective than coarser grades because it covered the bottom more evenly. All starfish in the outside experimental tanks died within 5 to 10 days after being treated with powdered calcium oxide. The chemical was applied at the rate of 300 pounds of powdered substance per acre of bottom.

In the spring of 1938 the experiments were transferred to the oyster beds of Long Island Sound where starfish are abundant. Both powdered and coarse grades of lime were used, the latter having been found to retain its effectiveness longer than the fine. The efficiency of the method on the natural oyster bottoms depends wholly upon the uniform distribution of calcium oxide particles over the treated area and upon the quantity of the chemical used. On 25 acres of starfish-infested oyster bottom treated with calcium oxide at the rate of 480 pounds per acre as many as 80 per cent. of the starfish were found to be affected by the chemical one week after the beginning of the experiment.

The destructive effect of calcium oxide upon starfish is produced by direct contact. Particles of the chemical quickly sink to the bottom, and, falling on the aboral surface of the starfish, imbed themselves in the ciliated epithelium covering the animal. Caustic action of the slaking chemical rapidly disintegrates the delicate skin membrane. The lesions rapidly increase in size, spreading in all directions and involving the branchiae and other surface structures. After several days the lesions penetrate the body wall and the internal organs become exposed. Death usually follows in a short time.

Once spread on the bottom, the chemical retains its effectiveness for some time. Starfish which are not directly hit by the falling particles when the chemical is applied eventually come in contact with it by crawling on the bottom. In the course of time the lower or oral surfaces of the starfish become affected and disintegration begins.

It has been observed that starfish with large lesions are usually attacked by other starfish and crabs which quickly kill and eat them.

The advantages of calcium oxide as a practical weapon against starfish are many. Of special importance is the fact that it does not appear to be very injurious to many other forms of marine life. No mortality has been observed among other bottom forms such as oysters, clams, several varieties of crabs, barnacles or adult flounders. Many of these animals were kept for as long as three months without apparent effect in large experimental tanks to which the chemical had been added. Studies on the effect of calcium oxide on plankton are now in progress.

Being at once effective and easy to apply, the new method is considered especially suitable for practical use. It should be of particular value in exterminating starfish on public or abandoned oyster bottoms, which, as shown by Loosanoff,[3] are the centers of propagation and dispersal of starfish in Long Island Sound.

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PREPARATION OF l-GLYCERIC ALDEHYDE

WE have prepared l-glyceric aldehyde in the following way:[1] l-arabinose → l-mannonolactone → l-mannitol → 1,2–5,6-diacetone-l-mannitol → acetone-l-glyceric aldehyde → l-glyceric aldehyde (2,4-dinitrophenylhydrazone m.p. 148°, dimedone compound m.p. 198–200°, $[\alpha]_D^{21°} = -198°$ in alcohol).

The optical rotations of the l- and d-glyceric aldehyde decrease after some time in aqueous solution from –14° to –7° and from +14° to +7°, respectively. However, the aldehyde content of the solution remains unchanged. By evaporating the aqueous solution to dryness, the higher-rotating forms of both aldehydes can be regained. Thus we have a kind of "mutarotation," *but no racemization.* This point seems to be important because of its biological consequences.

A complete report will be published elsewhere.

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[2] B. F. Wood, *Rept. State of Conn. Shellfish Comm.*, 94–98, 1908.

[3] V. L. Loosanoff, *Rept. State of Conn. Shellfish Comm.*, 10–14, 1936.

[1] Preparation of d-glyceraldehyde, *cf.* H. O. L. Fischer and E. Baer, *Helv.*, 19, 524, 1936.