

of the CH-4 arc (intensity: 5000 ft-c) filtered only through the water cells to remove heat. After an exposure of 45 min fertilization by normal sperm was not observed. Eggs similarly exposed but in 0.05 glycine remained fertilizable, as indicated by fertilization membrane formation or cleavage for at least double this time. Some became sticky in the glycine solution and adhered to the slide.

To extend the observations to spawn of a related form, the sand dollar *D. eccentricus*,³ and of the echiuroid worm *Urechis caupo*,⁴ were tested in a similar manner. The spawn of the sand dollar, diluted 1:200, resisted prolonged exposure (over an hour) to visible light from the CH-4 lamp filtered through the water cells and the #3060 Corning filter; therefore it was tested without the latter filter. In the absence of glycine a deterioration of spermatozoa occurred only after 30 min and was not marked until 40 min, after which exposure very few normal eggs were fertilized by addition of such spermatozoa. In the presence of glycine, however, comparable injury did not occur until after about 60 min exposure. There was little evidence of any protective action when a 1:2000 suspension of sand dollar sperm was tried, suggesting also a mass effect, which was not further investigated. The eggs were also relatively insensitive to the radiations from this lamp and fertilized normally even after more than an hour of exposure. Only after 2 hr exposure was a slight delay in cleavage observed. Clearly, the sand dollar spermatozoa and eggs are much less sensitive to visible light (and long ultraviolet light of this light source) than those of the sea urchin, although the two animals are not too distantly related.

Spermatozoa of *U. caupo*, in a 1:400 suspension proved to be highly resistant to visible light (3900 ft-c) of the CH-4 lamp passed through the Corning #3060 filter, as they are to ultraviolet light (7). After 40 min exposure, 95% (equivalent to the control) of the unexposed eggs added to the exposed sperm suspension were fertilized. After 60 min exposure a decline in fertilizing power of the spermatozoa occurred, only about two thirds of the eggs added being fertilized. After 80 min exposure still fewer were fertilized, and after an exposure of 145 min only about a third were fertilized. In all cases, observations were made for cleavage and formation of free-swimming larvae, to make sure that those eggs which failed to show membranes did not later cleave. *Urechis* spermatozoa in glycine sea water showed no significantly greater resistance to visible light than those in plain sea water.

The spermatozoa of *Urechis* were next treated to the full radiations of the CH-4 arc passed only through the water filters to remove heat. They proved much less resistant to the total radiations, which include some long wavelength ultraviolet light, than to visible light alone. After 10 min all eggs added to

exposed sperm were fertilized, but after 15 min exposure only about half of the eggs added to the exposed sperm were fertilized, and after 20–30 min none were fertilized or cleaved. Where fertilization occurred, trochophores appeared in a day (18° C).

Eggs of *Urechis* were also treated to the full radiations of the CH-4 arc (minus heat), and they proved quite resistant. After 60 min exposure to this lamp, they still cleaved normally when fertilized with normal sperm and gave rise to normal trochophores.

The experiments indicate that the spermatozoa of the purple sea urchin are much more sensitive to visible light injury than those of the sand dollar or the worm *Urechis*. The relatively greater effectiveness of the blue region of the spectrum in injuring sperm of the purple sea urchin suggests the presence in the sperm of some photosensitizer that has a maximal absorption in the blue. The mechanism of the sensitization of these spermatozoa to visible light should be susceptible to experimental analysis.

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Enzymatic Synthesis of Higher Carbohydrates from Dextrose

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By means of alcoholic fermentation, Pigman (1) observed the production of unfermentable carbohydrates by action of mold enzymes on maltose and reported no such synthesis from dextrose. Pan and associates (2) reported on the synthesizing action of *Aspergillus niger* enzymes on maltose, but the enzyme system failed to synthesize from dextrose. Tsuchiya *et al.* (3) have demonstrated by chromatographic techniques that *A. niger* enzymes synthesize oligosaccharides from maltose, isomaltose, and cellobiose, but direct synthesis from dextrose was not demonstrated.

TABLE 1

Progress in Synthesis of Dextrose	
Hours of incubation	Relative reducing value of mixture (%)
0	100
69½	93.4
142	89.4
167	88.5
191	88.3
214	87.7
238	87.4

³ Dredged in Monterey Bay between the Hopkins Marine Station and Fort Ord, Calif.

⁴ Collected at Elkhorn Slough near Moss Landing, Calif.

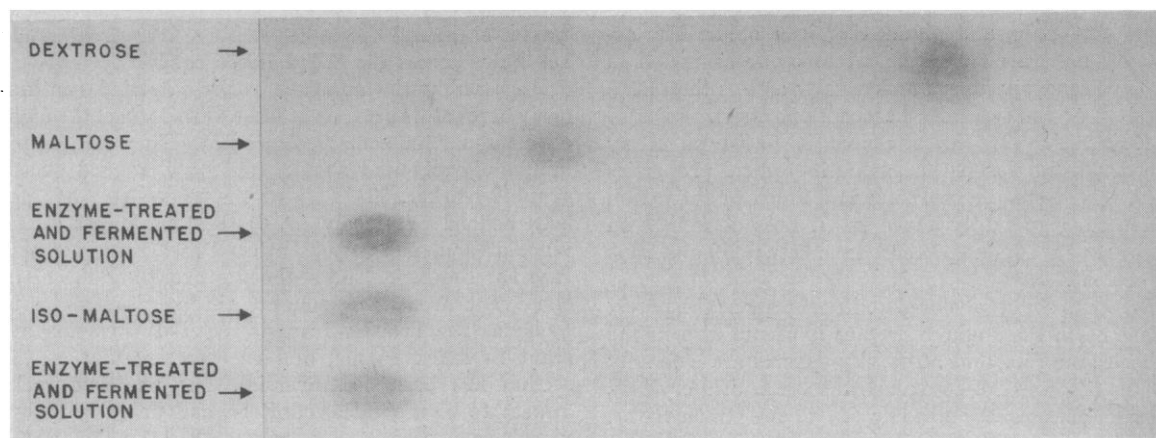


FIG. 1

We have observed the enzymatic synthesis of higher carbohydrates directly from dextrose, on which we wish to make a preliminary report.

A 47.5% dextrose solution, buffered to pH 4.6 with an acetate buffer (acetic acid-sodium acetate), and containing 4.07% of a purified precipitated enzyme preparation derived from *A. oryzae*, was kept under aseptic conditions for 238 hr at 53°-54° C. The enzyme preparation, which was assayed for α -amylase by the Sandstedt, Kneen, and Blish (4) procedure, contained 400 α -amylase u/g. Its Lintner value was 180 at 20° C. In addition, the enzyme preparation contained a relatively large amount of limit dextrinase.

The reducing value of the incubated mixture was determined by Lane-Eynon (5) titration at intervals in order to follow the progress of enzymatic synthesis. These values in terms of initial reducing value (100%) are shown in Table 1.

After 238 hr the fermentable carbohydrates were removed by fermentation with yeast; 66.6% of the dextrose originally present was fermentable. The fermented solution was decolorized with Darco, filtered with Celite, and evaporated to a syrupy consistency. No crystals have been obtained as yet.

The syrupy material was then chromatographed by the procedure of Jeanes, Wise, and Dimmler (6), using two descents to obtain the chromatogram shown in Fig. 1. In this chromatogram the mobility of duplicate spots of the sample was compared with dextrose, maltose, and isomaltose control spots. The chromatogram clearly shows that the unfermentable carbohydrates synthesized directly from dextrose by *A. oryzae* consist mainly of isomaltose. In addition, there is a smaller quantity of an oligosaccharide containing more than 2 dextrose units per molecule, since its mobility is less than that of isomaltose.

Preliminary experiments with an enzyme preparation derived from *A. niger* (NRRL 330)¹ also showed a synthesizing action on dextrose under identical conditions. The investigations will be continued.

¹ We are indebted to H. M. Tsuchiya, of the Northern Regional Research Laboratory, Peoria, Ill., for generously providing us with the *A. niger* (NRRL 330) culture filtrate.

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Analcime in the Popo Agie Member of the Chugwater Formation¹

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Analcime (analcite, $\text{NaSi}_2\text{Al}_{10}\text{O}_6 \cdot \text{H}_2\text{O}$) has been reported as a sedimentary mineral in only a few occurrences, and in no large quantity except in the Green River (1) formation. Special interest attaches, therefore, to the recognition of analcime as the prominent mineral in a section of sedimentary rock ranging in thickness up to about 60 ft, and extending over thousands of square miles. This analcime rock is the ocherous Popo Agie member (2) (originally called the Popo Agie Beds [3]) of the Triassic Chugwater formation of western Wyoming.

In previous field work which has been done on the Popo Agie its uncommon and distinctive lithology has been characterized variously as "ochre clay" (2), "sandy shale" (4), "oolitic claystone" (5), "mudstone" (6), and "siltstone and claystone" (7), without mention of analcime. Laboratory examination by the writer, of the ocherous and oolitic mudstone, shows the dominant mineral constituent to be analcime, which is accompanied by fine angular quartz silt,

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