X-Ray Investigation on the Change in Orientation of Cellulose in Sound and Infected Tracheids of Chir (*Pinus longifolia*)

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X-ray study of cellulose orientation in wood has developed into an interesting field of investigation. The cellulose content in wood varies from 40% to 60% and other components include lignin, resin, and fat. Clark (*3*) has made x-ray studies of wood of many species and has obtained the typical cellulose pattern in every case, but he found a considerable variation in the degree of preferred orientation. The tangential, radial, and cross-sectional structures are distinctly different. The orientations of cellulose may fluctuate considerably in different parts of the same tree and in different layers of the same cell wall, and frequently, in some tracheids, in different lamellae of the same layer as well (*2*).

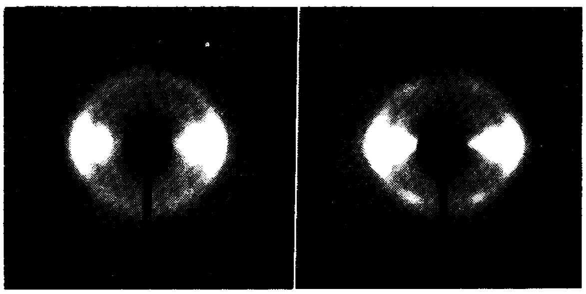

FIG. 1. *Left*—sound sample. *Right*—infected sample.

Bailey and Vestal (*1*), and Bailey and Berkley (*2*) made an interesting observation establishing that in certain ubiquitous fungi enzymatic hydrolysis progresses along the long axes of the fibrils of cellulose, and that the cavities so produced by the fungi are oriented with their long axes parallel to the long axes of the fibrils. It has since been microscopically noted (*4*), following the anatomical methods of Bailey and Vestal, that in chir (*Pinus longifolia*) sapwood infected by *Lenzites striata* there is no constant correlation between the orientation of cellulose and the plane of enzyme action. In the present investigation, small pieces of untreated chir sapwood, both sound and infected by *Lenzites striata* have been sampled from a block of chir sapwood (about 4 in. × 2 in.) and studied by x-rays. Photographs are taken in a cylindrical camera with the x-ray beam normal to the tracheal axis of the tangential section (Fig. 1). As such, the broad central layers of the secondary walls of chir tracheids are prominently exposed to x-rays.

It is evident from the photographs that the patterns, shape, and size of the two spots are not the same. In the case of the sound sample, the spots from the $10\bar{1}$ and 101-planes are diffuse and tend to merge into one interference ring and they are drawn into a long diffuse arc along the Debye-Scherrer ring. Similarly 002 interference is drawn into a long arc. But in the case of the infected sample, the corresponding spots are sharp and the other spots on the layer ring are also distinct. Consequently, the degree of disorientation of cellulose crystallites from the tracheal axis is much greater in the case of the sound sample of chir wood than that of the infected sample of the same wood, as has also been confirmed by critical microscopic examination of the central layer of secondary wall of chir tracheids. This clearly shows that the cellulose orientation can be changed by means of enzymatic hydrolysis.

Work is in progress to determine the degree of disorientation of the structural units of cellulose from the fiber axis by measuring the distribution of intensities along the length of the 002 spot with chir wood at various stages of decay.

[1] Thanks are due to Prof. K. Banerjee, D.Sc., F.N.I., for his keen interest during the progress of this work.

References

1. BAILEY, I. W. and VESTAL, MARY R. *J. Arnold Arboretum*, 1937, **18**, 195.
2. BAILEY, I. W. and BERKLEY, EARL E. *Amer. J. Bot.*. 1942, **29**, 235.
3. CLARK, G. L. *Ind. eng. Chem.*, 1930, **22**, 474.
4. SEN, J. *Sci. Cul.*, 1948, **14**, 163.

A Preliminary Note on Naturally Occurring Organic Substances in Sea Water Affecting the Feeding of Oysters[1]

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In studying the role of certain industrial wastes in the ecology and physiology of oysters, we have found a significant correlation between the pumping rate of the oyster and a hitherto unreported factor naturally present in minute amounts in sea water. We designate this factor as carbohydrate because it is measured photometrically with the *N*-ethyl-carbazole reagent which can be used quantitatively for estimating minute amounts of carbohydrates.[3] The active agent may be a true carbohydrate, or it may be some other compound which happens to be quantitatively associated with the carbohydrates responding to the test.

The characteristics of the substance as it occurs in the natural sea water supply of this laboratory are as follows: It passes bacteriological filters and is not thrown down by the ordinary laboratory centrifuge. The con-

[1] This work is being done as part of an independent investigation by the authors, to whom the facilities of the U. S. Fisheries Station at Pensacola have been kindly made available by the U. S. Fish and Wildlife Service.

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[3] We wish to acknowledge the assistance of Dr. J. Gordon Erdman, of the Mellon Institute, in suggesting the method as well as adapting it to our particular needs.

centration in different samples ranges from 2 to 25 mg/l and is extremely variable. Concentration in a single sample is constant for 4 days at room temperature (25°–30° C), after which it takes a sharp drop. A short period of boiling does not change the concentration.

The following characteristics of the oysters' behavior in response to the substance are clearly indicated now: The response is directly correlated with changing concentrations; other factors being equal, the greater the carbohydrate concentration the more water the oyster pumps.

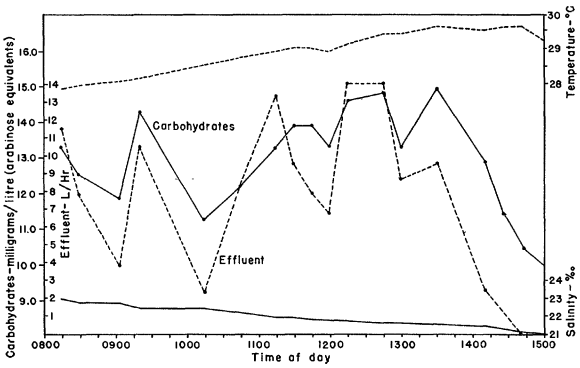

FIG. 1. Relationship between carbohydrate concentration (mg/l in terms of arabinose) and the effluent of a single oyster measured simultaneously. Salinity and temperature determinations were also made at the same moment. The depressed value for the effluent shown in hour 1100 was caused by a normal reflex closure of the valves of the oyster for voiding irritating solids.

The threshold value for pumping varies from oyster to oyster, but thus far (continuous bihourly observations started May 10, 1949) no oyster has remained open and pumped water when the concentration fell below 4.8 mg/l. As the water temperatures increase, the carbohydrate threshold for continued pumping seems to rise. Temperature appears to become especially critical above 28° C, the carbohydrate threshold rising to about 12 mg/l. Salinity variations within wide limits do not play a part. With salinity and temperature conditions within the optimum ranges but with the carbohydrate level below the threshold indicated, the oyster will open for a short period of time which we have come to call a ''testing period.'' If this period coincides with a high carbohydrate value the oyster will immediately begin pumping; if it does not the oyster will close. We have observed this behavior for days at a time. The carbohydrate value can be high for 2 or 3 hr or longer without the oyster's ''testing,'' in which case it will miss the high carbohydrate completely. Detailed, minute-by-minute observation demonstrates an almost immediate response of the oyster to changes in the concentration. (See Fig. 1.) The oyster removes from 5% to 15% of the substance from the water passed through its body.

In addition to the short interval observations shown in Fig. 1, we have now accumulated bihourly observations (24 hr per day) on ten oysters. As many as four of these have been run simultaneously for 30 days. Pairs have been run as long as 60 days. These long term studies are being projected into a field program to determine the ecological significance of this carbohydrate factor.

Experimental work is still in progress and all conclusions must remain tentative, but the indications listed above seem clear enough and of sufficient significance to be presented now. These results are particularly significant in the light of the work of Pütter (*4*), Krogh (*2*), Yonge (*5*), MacGinitie (*3*), Coe (*1*), and others.

References

1. COE, WESLEY R. *J. marine Res.*, 1949, **7**, 586.
2. KROGH, AUGUST. *Biol. Rev.*, 1931, **6**, 412.
3. MACGINITIE, G. E. *Biol. Bull.*, 1945, **28**, 107.
4. PÜTTER, A. *Arch. ges. Physiol.*, 1911, **137**, 595.
5. YONGE, C. M. *J. Mar. biol. Assoc. U. K.*, 1928, **15**, 643; review, H. BLEGVAD, *J. du Cons.*, 1928, **4**, 124.

Maleic Hydrazide, a Selective Herbicide

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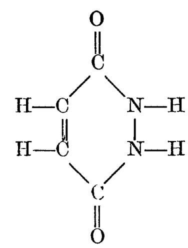
Among several products known to have growth-regulating properties and submitted to us for testing by the Naugatuck Chemical Division, U. S. Rubber Company, Naugatuck, Connecticut, was a sample of maleic hydrazide. It has the formula



and was supplied as the diethanolamine salt. The effect of maleic hydrazide on tomato plants was described as inhibitory (*1*); plants stopped growing for several weeks then resumed normal growth with little apparent injury. The amount of inhibition was proportional to the concentration employed.

Tests on barley and cotton reported here indicate that this compound may possibly prove to be a valuable selective herbicide. Two-week-old barley (var. Sacramento) and 5-week-old Upland cotton (var. Acala), grown in gallon cans, were sprayed to runoff in accordance with the tentative recommendations accompanying the product. The equivalent of 0.2% maleic hydrazide was used in aqueous solution, to which in some instances 0.024% Vatsol was added as a spreader. Spraying was carried out by means of an atomizer under constant pressure, with the plants on a revolving platform.

The immediate effect of maleic hydrazide on barley was to stop growth. This was detected a few days after treatment. Leaves turned dark green and slowly died back from the tips. After approximately 6 weeks, the barley was completely dead but the cotton was apparently