

MARINE NATURAL PRODUCTS III.¹ JOHNSTONOL,
AN UNUSUAL HALOGENATED EPOXIDE FROM THE
RED ALGA LAURENCIA JOHNSTONII

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Seaweed of the genus Laurencia have in recent years provided an interesting array of brominated natural products.² In the course of investigating the reported antifungal activity of extracts of some members of the genus,³ we earlier isolated a new sesquiterpene, pacifenol⁴ (I), from L. Pacifica. This work describes the isolation and characterization of another new compound, johnstonol (II), from L. johnstonii.

Laurencia johnstonii occurs uniquely in the north of the Gulf of California where it appears frequently as a bright green plant. The dried, pulverized plants were extracted with methanol, the methanol concentrate was partitioned into ether and the ether concentrate was chromatographed on Davison Grade 62 Silca Gel. The 20% ether: 80% benzene eluent contained crystalline (m.p. 178°/ethyl acetate) johnstonol (II). Analytical data indicated the formula $C_{15}H_{21}O_3Br_2Cl$.

The colorless orthorhombic needles of johnstonol obtained by recrystallization from ethyl acetate were subjected to x-ray crystallographic analysis. The cell constants $a = 13.115$ (9) $b = 13.46$ (1) and $c = 9.455$ (8) Å, were determined from a least squares fit of 12 carefully centered high angle reflections using $Mo K\alpha_1$ radiation ($\lambda = 0.70926$ Å). Systematic absences uniquely established the space group as $P2_12_12_1$ (#19) and the crystal density was 1.77 gm/cc;

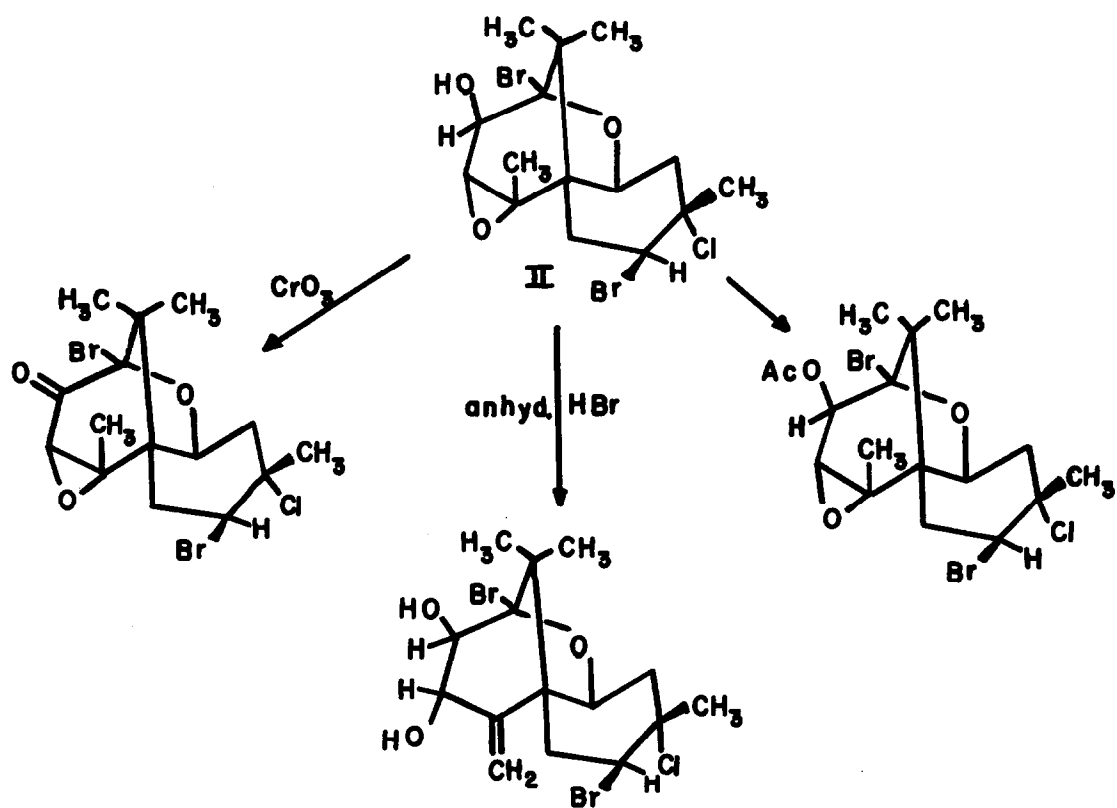
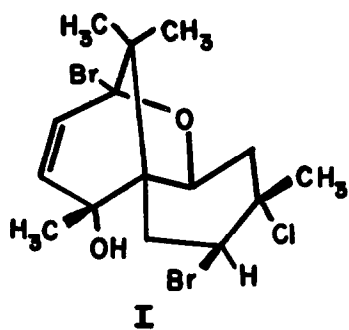
1.767 gm/cc being required for 4 molecules per unit cell.

Reflection data were collected under computer control with a Picker four-circle diffractometer using instrumental parameters previously described.⁴ The crystal turned orange-brown during the data collection with this decomposition showing up equally in the 3 standard reflections as a monotonic 10% loss of intensity over the two days required to collect the 949 unique reflections within a sphere with maximum $\sin \theta/\lambda$ of 0.49 \AA^{-1} . Mo K α radiation made monochromatic by Bragg reflection from a graphite crystal was used in collecting the intensities and two complete data sets having a discrepancy index of ca. 3% were collected as an additional check on sample decomposition vide supra. The data were corrected for the extant decomposition by normalizing to the initial intensities of the standards. The structure was readily solved by heavy atom methods and after refinement to a residue, R (based on F) of 9.5% the absolute configuration was confirmed using the anomalous dispersion effect of the bromine atoms ($wR = 12.4\%$ versus 13.5% for the enantiomer).⁵ Refinement was then continued by full matrix least squares methods (the two bromine and chlorine atoms were allowed to vibrate anisotropically), converging to a final weighted residue (wR) of 8.5% for the 890 reflections which were above background by a least 3σ . The standard deviation of a observation of unit weight is 2.8, and the unweighted residue (R) is 6.8%.

The conformation and absolute configuration of II is identical to that of its near relative pacifenol I, and all structural parameters are consistent with accepted literature values.

Chemical transformations which have been carried out on II are outlined in the figure. All structures were rigorously determined from analytical and spectral data. These results fully confirm the nature of the epoxy-alcohol functionality in II.

We have now investigated L. pacifica, L. johnstonii, L. spectabilis and L. splendens. The latter two were collected in the Monterey, California region and the others at roughly the latitude of San Diego. We note here that L. splendens and L. spectabilis have neither I or II and that L. johnstonii contains II and traces of I and L. pacifica contains I and traces of II. In



addition we now know that the "dibromide" (of unknown structure) isolated by Irie^{6,7} from L. okamurai is in fact II. Thus I and II appear to be common in the Laurencia genus but not ubiquitous.

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7. Established by comparison of ir and nmr spectra of the acetate derivatives from both labs. The compounds have the same absolute configurations as established by their identical specific rotations at the Sodium D line. We are grateful to Professor Irie for the exchange of data.