

temperature and the maximum polarization for a given field strength amplitude is smaller, probably due to incomplete saturation.

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¹ Sawyer, C. B., and Tower, C. H., *Phys. Rev.*, **35**, 269 (1930).

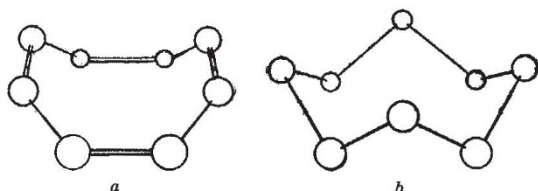
² Wul, B., and Goldman, I. M., *C.R. Acad. Sci. U.R.S.S.*, **51**, 21 (1946).

³ Rushman, D. F., and Strivens, M. A., *Trans. Farad. Soc.*, **42** A, 231 (1946). Von Hippel, A., Breckenridge, R. G., Chesley, F. G., and Tisza, L., *Ind. and Eng. Chem.*, **38**, 1097 (1946).

The 'Octa-Benzene', Cyclo-octatetraene (C_8H_8)

THE fact that cyclo-octatetraene—in contrast to benzene—shows a markedly unsaturated character has generally been used as an argument in favour of the assumption that the molecule contains alternate double and single bonds. The resonance energy, which is not much smaller per CH-group than that of benzene, makes the correctness of this assumption seem rather doubtful. On the other hand, a preliminary Raman analysis leads E. R. Lippincott and R. C. Lord, jun.¹, to believe that the spectrum can best be interpreted on the basis of a puckered eight-membered ring with alternate single and double bonds.

An electron diffraction analysis of the vapour carried out recently, using the sector method, leads to a different conclusion. This analysis indicates that all the C—C bonds are equivalent, and that the C—C—C angles are 120° just as in benzene. The C—C distance is not much greater than that of benzene (about 2 per cent).



The distribution curve ($\sigma(r)/r$) directly obtained from experiment was compared with theoretical curves based on the following models: (1) plane ring, (2) puckered ring with alternate double and single bonds, (3) puckered ring with equivalent bond, varying the C—H distance within a reasonable range. In case 3 only was satisfactory agreement obtained. The carbon skeleton of a model based on the assumption of alternate double and single bonds is reproduced in Fig. a, the carbon ring of the model resulting from the electron diffraction investigation in Fig. b. (It is, of course, possible that the bonds of Fig. b are not strictly equivalent. In this case, however, the difference between the two types of bonds is too small to be detected interferometrically.)

The 120° angle between C—C bonds indicates the presence of σ -bonds (ps^2 -bonds). The additional π -bonds are based on p -orbitals perpendicular to the plane of the σ -bonds. The overlapping of two neighbouring p -orbitals is weaker than in the case of benzene because their directions are no longer parallel. It may thus be understood that the C—C distance is greater and the unsaturated character more pronounced than in the case of benzene.

We have further reinvestigated the Raman spectrum of cyclo-octatetraene. Our measurements

in the frequency region below 2,000 cm^{-1} (that is, excluding the complicated region of hydrogen-stretching frequencies) are given in the accompanying table.

Frequency (cm^{-1})	Intensity	Polarization	
200 (broad)	8	P	
254	3	D	
298	3	D	
370	6	D	
659	1	D?	
876.8	8	P	
953	4	D	
1209	6	D	
1220	2	D?	
1442	6	D	
1459	0	—	1209 + 254 = 1463
1608	1	D?	
1639	2	D?	1442 + 200 = 1642
1655.5	10	P	
1748	0	—	2 × 876.8 = 1754

In agreement with Lippincott and Lord¹, we have found only three of the Raman lines to be polarized. We have, however, failed to observe several frequencies reported as weak lines by these authors. As seen from the table, three of the fifteen Raman lines observed by us may be explained as combination tones, leaving twelve frequencies to be interpreted as Raman active fundamentals. This is in agreement with the D_{4d} symmetry which requires three polarized and nine depolarized Raman lines in this frequency region. As a D_4 or a D_{2d} structure should give rise to five polarized and 18 resp. 17 depolarized lines, we believe that the Raman spectrum can best be interpreted on the basis of the D_{4d} model.

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¹ Lippincott, E. R., and Lord, jun., R. C., *J. Amer. Chem. Soc.*, **68**, 1868 (1946).

A Pulse Method for the Measurement of Ultrasonic Absorption in Liquids: Results for Water

It is well known that measurements of the absorption of ultrasonic waves in liquids¹⁻³ often do not show good agreement, and that for numerous liquids they indicate absorption coefficients many times those calculated on the assumption of a purely viscous loss. Because of these discrepancies it was considered useful to make measurements by a new technique, and one was chosen which would remove many of the possible objections to previous methods. A 'radar pulse' technique was developed, in which a short wave-train was emitted in a narrow pencil from a quartz oscillator; the sound, after travelling through the liquid, was reflected and received by the same quartz plate, which thus acted as a common 'transmit-receive' transducer.

The amplitude of the received pulse was measured as a function of the distance to the reflector. By driving the quartz crystal on its fundamental and 3rd, 5th, 7th and 9th harmonics, it was possible to measure absorption of waves on five frequencies from 7.37 to 66.1 Mc./s. A sixth frequency, 15 Mc./s., was added by changing the crystal. A feature of the technique was the elimination of errors due to diffraction; concordant measurements were made in both the Fraunhofer and Fresnel diffraction zones of the quartz disk. In the case of small absorption,