

1927

## Molecular Space Array in X-Ray Diffraction Halos in a Liquid: The Case of Liquid Normal Primary Alcohols: The Cybotatic State

G. W. Stewart  
*State University of Iowa*

Roger M. Morrow  
*State University of Iowa*

Copyright © Copyright 1927 by the Iowa Academy of Science, Inc.  
Follow this and additional works at: <https://scholarworks.uni.edu/pias>

---

### Recommended Citation

Stewart, G. W. and Morrow, Roger M. (1927) "Molecular Space Array in X-Ray Diffraction Halos in a Liquid: The Case of Liquid Normal Primary Alcohols: The Cybotatic State," *Proceedings of the Iowa Academy of Science*, 34(1), 280-281.  
Available at: <https://scholarworks.uni.edu/pias/vol34/iss1/83>

This Research is brought to you for free and open access by the Iowa Academy of Science at UNI ScholarWorks. It has been accepted for inclusion in Proceedings of the Iowa Academy of Science by an authorized editor of UNI ScholarWorks. For more information, please contact [scholarworks@uni.edu](mailto:scholarworks@uni.edu).

Professor Charles Sheard in the Section of Physics at the Mayo Clinic, Rochester, Minnesota.

IOWA STATE COLLEGE,  
AMES, IOWA.

---

MOLECULAR SPACE ARRAY IN X-RAY DIFFRACTION  
HALOS IN A LIQUID: THE CASE OF LIQUID NORMAL  
PRIMARY ALCOHOLS: THE CYBOTATIC STATE

G. W. STEWART AND ROGER M. MORROW

For more than a decade (Debye and Scherrer, *Nachr. Gesell. Göttingen* (1916), p. 6) the X-ray circular diffraction halo in liquids has been known. Doubtless numerous times the suggestion has been made (vide Hewlett, *Phys. Rev.* 20 (1922), p. 688, and others) that there is in the liquid a spacial arrangement of molecules, probably as fragmentary crystals. But definite evidence of such a structure has been lacking. The authors have investigated by means of  $M_oK\alpha$  x-radiation the liquid normal primary alcohols from ethyl to lauryl and have obtained the following:

1. There are two significant distances determined by diffraction intensity peaks.

2. One of these distances remains fairly constant, varying from 4.6 Å with lauryl,  $C_{11}H_{23}(OH)$ , to 4.4 Å with butyl,  $C_4H_9(OH)$ , and then decreasing more rapidly to methyl,  $CH_3(OH)$ , 3.8 Å.

3. The other distance varies linearly with the content of  $CH_2$  in the molecule, the variation for each such addition being approximately 1.54 Å. The distance for lauryl is about 22 Å.

4. The evidence leads to the conclusion that the latter distance is occasioned by the length of the chain molecule and the former by the distance of separation of molecules perpendicular to the chain.

5. From computation of density and from the polarity of the compound, one finds that two CH polar groups appear to unite, making a chain two molecules in length, and that the planes containing these groups are not perpendicular to the chains.

6. The addition of each  $CH_2$  lengthens the molecule by approximately 1.3 Å, which is of the same order as crystalline C distances, and is in agreement with the similar experiments of Müller and Saville (*Journal Chem. Soc.*, Vol. 127 (1925), p. 599) and earlier observers on solid long chain hydrocarbons. The above interpretation of distance of separation of chains and relative

positions of heads, is in agreement (within the error of our experiment) with the calculations of Adam (Proc. of Roy. Soc. (1921), (1922), (1923)), who found the area of cross section occupied by each saturated fatty acid chain on the surface of water was  $21.0 \times 10^{-16} \text{cm}^2$ , and this is equal to  $(4.58 \times 10^{-8})^2 \text{cm}^2$ .

In the experiments the peak width was over  $3^\circ$  whereas the width for the same radiation diffraction from a crystal was about  $0.4^\circ$ .

The experiments indicate clearly a definite space array. Comparisons of peaks in liquid and solid state at approximately the same temperature show that the computed spacings are not the same. The space array in the liquid is not crystalline, but is one in which molecular mobility is permitted and the resulting peaks represent the most probable spacings. A name is proposed for this non-crystalline, space-array state. The noun is cybotaxis and the adjective cybotactic.

This conception of the liquid state gives a description of a "solution" and contributes to various theories in connection with liquids. The experiments and discussion will soon be published in full.

STATE UNIVERSITY OF IOWA,  
IOWA CITY, IOWA.

---

## THE CORRELATION BETWEEN STUDENTS' GRADES IN HIGH SCHOOL AND COLLEGE PHYSICS

CHESTER KING AND JOHN LEIST

This study was undertaken in order to find out to what extent the achievement of a student in college Physics was similar to his achievement in high school Physics.

The high school grades for the entire course of Physics were used in comparison to the first semester grades in college Physics. The data covers the records of students who entered college during a period of three years. The total number of students considered was one hundred twenty-one. With this group the formula proposed by Karl Pearson showed the coefficient of correlation to be 0.62. This is considered quite a marked correlation.

In the above group there were 81 boys and 40 girls. The coefficient for the boys was 0.44 and that for the girls was 0.53. This might be considered as added evidence that the girls are more dependable in their studies while in high school, and that the boys