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Dorothy Crowfoot Hodgkin: Captured for Life by Chemistry and Crystals

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Dorothy Crowfoot Hodgkin

Captured for life by chemistry and crystals

Personal life and education[1]

- Born in Cairo, Egypt in 1910
- Studied Chemistry at Oxford, 1928-1932
- PhD at Cambridge, 1932-1934
- Married Thomas Hodgkin, educator
- 3 children: a mathematician, a historian and a botanist
- Died in 1994

Awards:[1]

- Royal Society's Medal
- Wolfson Research Professorship
- Elected to Royal Academy in 1947
- Foreign member of Royal Netherlands Academy of Sciences in 1956
- Member of American Academy of Arts and Sciences (Boston) in 1958
- Involved in founding of the International Union of Crystallography
- Nobel Prize in Chemistry in 1964

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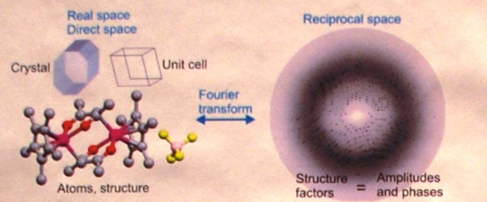
Area of expertise: X-ray crystallography[3]

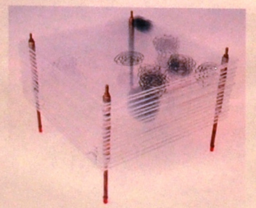


$$\rho(xyz) = \frac{1}{V}\sum_{hkl=-\infty}^{+\infty} \underbrace{|F(hkl)|}_{\text{Amplitudes}} \cdot e^{-2\pi i[hx+ky+lz-\underbrace{\phi(hkl)}_{\text{Phases}}]}$$

- When Hodgkin first began her work, X-ray crystallography was used to create 2-dimensional maps of molecules.
- X-ray beams are passed through crystals and complicated equations of resulting diffractions can determine the atomic structure
- When Hodgkin began working on the structure of penicillin, all calculations were done by hand on "Beevers-Lipson strips."
- Hodgkin contributed to the development of X-ray crystallography by pioneering new techniques for 3-dimensional mapping and solving problems with existing techniques.

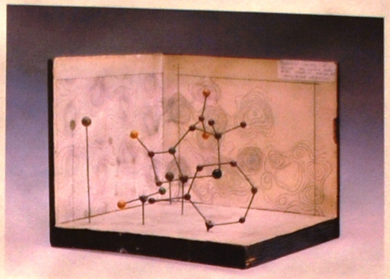
X-ray Crystallography in the beginning[3]

Beevers-Lipson strips, tools for calculations done by hand



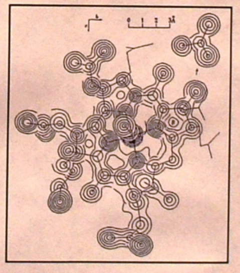
Hodgkin pioneered the use of clear stacked electron-density maps to simulate a 3-dimensional structure.

First major contribution to X-ray crystallography: The structure of penicillin[3]

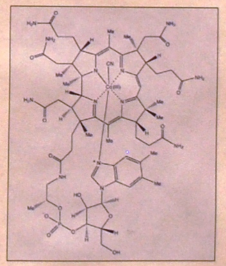


Dorothy Hodgkin always dreamed of being able to truly "see" the molecules she studied. She said, "Would it not be better if one could really 'see' whether molecules as complicated as the sterols, or strychnine were just as experiment suggested*(4)*?"

2nd major contribution: the structure of vitamin B12



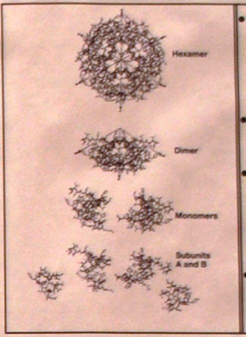
Electron-density map*(5)*



Molecular structure*(2)*

- This is the model of vitamin B12 build by Hodgkin*(6)*.
- Computers were began to be used for calculations, making work much easier*(1)*.
- A big surprise in this discovery was the presence of cobalt. Vitamin B12 was the first known cyano-metallic organic compound*(1)*.

3rd major contribution the structure of Insulin*(1)*



- Insulin is a very complicated compound made up of 2 chains, subunits A&B
- The subunits combine and form monomers
- Two monomers form dimers, and 3 dimers form hexamers in the presence of zinc
- Hexamers conglomerate with many other hex-

- Hodgkin was the first to take X-ray photographs of the compound in 1934.
- Hodgkin was retired when she and her colleagues finally were able to describe insulin's complex structure

Conclusion

Dorothy Crowfoot Hodgkin's pioneering work in X-ray crystallography made a lasting impact on many scientific fields, including medicine and biochemistry. Her discoveries paved the way for others to develop new antibiotics, cancer treatments and imaging techniques. Every year, scientists gather at Oxford to remember Hodgkin and her contributions.

References

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5. Robertson, J. Monteath *Problems of Organic Structures*, 1999, http://www.iucr.org/publ/50yearsofxraydiffraction/full-text/organic-structures (November 8, 2014)
6. Highfield, Roger *Google Doodle celebrates pioneering chemist Dorothy Hodgkin's 104th birthday*, 2014, http://blog.sciencemuseum.org.uk/insight/2014/05/12/google-doodle-celebrates-pioneering-chemist-dorothy-hodgkins-104th-birthday/ (November 8, 2014)