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Book reviews

Three-Dimensional Electron Microscopy of Macromolecular Assemblies, J. Frank. Oxford University Press, Inc., New York, NY, USA (2006). xiv + 410 pp., £58-00, ISBN: 0-19-518218-9

Macromolecules are very important nowadays in our life. To understand their functions, it is necessary to know how they are built. Macromolecular structure investigation is a good means to reach that goal. Different techniques have been used to try to reveal the structure of the macromolecule. Electron Microscopy is one of them and, for the last decade, it has been of a great importance in the determination of the structure of macromolecular assemblies. *Three-Dimensional Electron Microscopy of Macromolecular Assemblies* explains the importance of the three-dimensional electron microscopy technique to determine the structure of macromolecular assemblies. It contains six chapters that each treats one aspect of that technique.

The introductory chapter notes the growing importance of Electron Microscopy in the evolution of Biology. Principles of the Transmission Electron Microscope, specimen preparation methods, principle of image formation in the transmission Electron Microscope and finally special imaging techniques and devices are explained in the second chapter. Once images are obtained, they need to be processed. The third chapter's purpose is to describe the theory underlying image averaging, the practical tools used to align images, and frequently used measures of reproducibility and variability. Classification, the main theme of the fourth chapter, is the system of division of a set of images into subsets with similar features. In highly ordered biological objects which form two-dimensional (2D) crystals, or helical or icosahedral assemblies, it could be said that classification has already taken place, by virtue of the equivalence of intermolecular chemical forces, which assures that only blocks that are alike are assembled whereas in the reconstruction of a molecule from single particles, classification of images according to orientation, conformation and state of ligand binding must be done computationally at the level of image data.

Three-dimensional reconstruction of objects is initially described by some mathematical principles underlying reconstruction (chapter 5), then, there is an overview of different data collection schemes and reconstruction strategies. The following practical part approaches reconstruction through three strategies: random conical, common lines and reference based. The important problem of resolution assessment and the treatment of Contrast Transfer Function (CTF) correction necessary to obtain reconstruction faithful to the object are considered. The chapter concludes with three sections devoted to special problems: how to compensate for large angular gaps in the data set by a process called restoration, how to deal with heterogeneous data sets (projections) and how to align density maps resulting from different reconstructions. The last chapter is about the question of interpretation of the three-dimensional images of macromolecules. Different considerations need to be underlined and this raises some questions: when, as a function of spatial separation and density separation, are differences in density between two points of a reconstruction significant, if one obtains two reconstructions of a molecule in different states, what are the criteria for pronouncing the observed density differences statistically significant and what assurance do we have that the features we use in a reconstruction represents something real?

This book shows that Three-Dimensional Electron Microscopy is an important technique for the determination of the Macromolecular Assemblies structure. It explains theoretical aspects to consider and shows some practical examples where this technique has been successfully used to deal with that matter. Electron Microscopy appears to be a recommendable technique for anyone who is looking for an appropriate tool to study macromolecules

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