Structural Crystallography of Inorganic Oxysalts

While it can certainly be stated that the structural chemistry of inorganic oxysalts has been heavily developed over the last century, the past decade has seen a massive increase in the diversity of structure types owing to advances in both synthetic methods and single-crystal X-ray diffraction instrumentation. This is exemplified by uranyl oxoanion compounds, where new anionic topologies more than doubled over the course of eight years. It is no longer enough to merely state that one has discovered a new structure type, but rather it is equally important to understand how new structures are related to known ones. The most important development in understanding the relationships between these compounds has been to categorize them according to their topological families.

In his book *Structural Crystallography of Inorganic Oxysalts*, Sergey V. Krivovichev does a superb job of developing and applying graph theory to both low-dimensional and framework heteropolyhedral structures. In doing so we are now able to relate a plethora of complex topologies to one another. Many surprises have arisen as the result of this classification system. One of these is that compounds that are compositionally very distinct from one another can adopt the same topologies.

As a result of examining and classifying inorganic oxysalts have we now reached the point where we can accurately predict structure based on composition? Or better yet, can we predict how structures will transform in chemical reactions? The answer to the first question is: probably not. There is still much more work to be done in understanding the solid-state chemistry of oxoanion compounds before this might be accomplished. There is however some hope in both understanding and predicting structural transformations using the principle of dimensional reduction, which while well known as a phenomenon in solid-state chemistry for many years, was formulized and applied to rhenium chalcogenide cluster compounds in the 1990s by R. H. Holm and J. R. Long. This principle has far-reaching applications and can even be applied to compounds as complex as uranyl molybdates.

I highly recommend this book to two audiences. First, for current investigators of the synthesis and structure of oxysalts, this book is simply a necessity. It is filled with numerous groupings of topological families of compounds, and allows for rapid classification of new compounds. The second group is also obvious. Those researchers working to develop structure–property relationships will find this compendium very useful. Many of the structures beg questions of utilization in fields ranging from ionic conductivity to nonlinear optics. In many ways this book follows in the footsteps of A. F. Wells' *Structural Inorganic Chemistry*, yet it is much more sophisticated.

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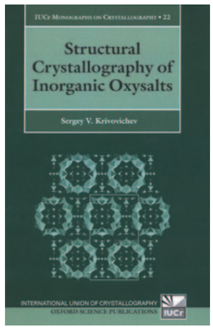
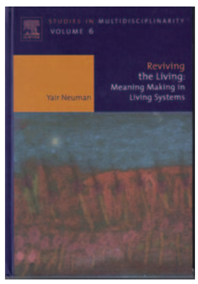


Structural Crystallography of Inorganic Oxysalts
IUCr Monographs on Crystallography No. 22. By Sergey V. Krivovichev. Oxford University Press, Oxford 2009. 320 pp., hardcover, $ 130.00.—ISBN 978-0199213207

Reviving the Living

In his current book, Yair Neuman (Ben-Gurion University of the Negev, Israel) gives an introduction to living systems by outlining their most prominent features, that is, their irreducibility and hierarchical organization as well as their ability to differentiate. To differentiate or to distinguish means that living systems are capable of interacting with their environment in specific ways. For example, a cell may or may not express a receptor for a certain hormone, in the former case making a difference in the presence of that hormone while not in the latter. Living systems thus "choose" or select from their environment what makes sense to them by obeying several rules arising from evolution. This is highlighted with the transition of protocells, as pure chemical systems, to living systems. But how do they do this? What are the underlying principles and how did they evolve? Neuman provides insight into such problems and predisposes readers not familiar with these topics how to deal with reductionism as well as sheding light on life from an often unnoticed perspective.

By comparing the genetic system (or genetic code) with a language. he delves into the realm of semiosis (sign usage). Sign usage means that relationships are built between two entities through the mediation of a "third party" (sign). This mediation through signs, which can also be described as adaptor molecules (for example, tRNAs) at the molecular level, mark a major transition in thinking about living cells and organisms. The organization of complex systems such as cells is seen from the level of representation, which can be distinguished from simple signal processing. The ability of cells and organisms to engage in sign usage is central to Neuman's main topic, that of meaning-making. By introducing language con-



Reviving the Living
Meaning Making in Living Systems. By Yair Neuman. Elsevier Science, 2008. 320 pp., hardcover $ 185.00.—ISBN 978-0444530332

cepts, starting with the genetic code, he develops further the ideas of biological information and combines this with a view on information from a computational perspective.

From this point on, readers become familiar with this special kind of thinking and can consider the holy grail of meaning-making: the immune system. The author sheds light on the ability of the immune system to generate meaning in context, or better still due to context, and the way "self" versus "nonself" comes into being, and concludes that "… being out-of-context is being meaningless." Something matters for a living being only because it happens at a distinct time and in a distinct molecular or environmental constellation with reference to the evolutionary memory or history of that organism, be it a single-celled bacterium or multicellular animal. As the author points out, it is a history of oblivion, which means that memory not only encompasses storage, but also relies on the ability to forget, a topic that is shown by several authors ("Landauers erasure principle") to conform with the laws of thermodynamics. A main point of Neuman is, thus, how "self" (either immune self, or single-cell self) instantiates and is maintained, both processes where signs seem to be a plausible explanation, and a way how living systems may define their borders. Neuman takes us on a short trip from complexity to individuality and reveals the uniqueness of organisms.

The book is organized into three parts containing 17 chapters. The chapters are short and Neuman does a great job in bringing together several disciplines, such as linguistics, philosophy (epistemology), physics, chemistry, computational science, and biology throughout, at the same time avoiding jargon. With this highly accessible and clear style, it is suitable for a broad interdisciplinary readership, especially for students. Neuman's approach is an ingenious way to introduce an issue and predispose readers to other fields by dealing with the important questions of the respective field: knowing what is not known about a discipline may be much more informative than the other way around. This is exactly what Neuman does here. In addition, he provides some clues on the bio-principles ruling life. Although the book does not go into detail for many points, and thus is neither a review nor a resource, it is a compilation of highly interesting topics that will undoubtedly transform the way readers think about organisms. According to Gregory Bateson's famous statement "a difference which makes a difference", the book makes a difference and is a difference—at least in this reader's mind.

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