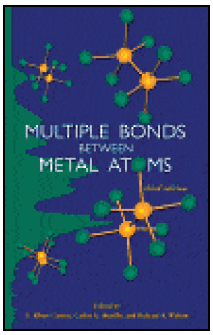
## Multiple Bonds between Metal Atoms




3rd Edition Edited by *F. Albert Cotton*, *Carlos A. Murillo* and *Richard A. Walton*. Springer Science, New York 2005. 818 pp., hardcover $ 149.00.—ISBN 0-387-25084-0

Chromium(II) acetate, prepared by Eugène-Melchoir Peligot in 1844, was the first compound discovered that contained a quadruple bond (a chemical bond between two atoms involving eight electrons, that is, an extension of the familiar double and triple bonds), but its unusual bonding was not recognized for more than a century. It was only in 1964 that a quadruple bond was first characterized—by F. Albert Cotton—in potassium octachlorodirhenate(III), $K_2[Re_2Cl_8]\cdot 2H_2O$). Initially considered by many chemists as an "anomaly" or rare bonding mode, this ion was shown by subsequent work of Cotton and his students to be the progenitor of a vast new area of chemistry. Thus, in contrast to most scientific advances, which proceed on a number of fronts through contributions by a large number of researchers, this field is primarily the result of the work of Cotton's group.

By the early 1980s, the synthetic methodologies, reaction chemistries, and bonding theories were well understood, and had reached a sufficient level of maturity to justify a comprehensive treatise. Therefore, Cotton and Richard A. Walton wrote their monograph on this class of inorganic molecules that do not conform to classical bonding theories (*Multiple Bonds between Metal Atoms*; see book review in: *Angew. Chem. Int. Ed. Engl.* **1983**, *22*, 563). They placed the most important discoveries in the field in historical perspective, and discussed all the pertinent literature up to the end of December 1980, also referring to key developments that emerged during the early part of 1981.

During the next decade, the field experienced a much more rapid growth than previously, and metal–metal bonding became accepted as a major pattern in transition-metal complexes, especially in low oxidation states. Cotton and Walton therefore wrote a second edition (1993), which included not only complete coverage of those topics appearing in the first edition but also all significant advances published up to December 1990, as well as most of the literature appearing throughout 1991. The great increase in the literature required a compromise in the depth of treatment of certain topics, to keep the book to a reasonable length.

Soon after this publication, Cotton and Walton recognized the need for a new up-to-date edition. However, because of the accelerating expansion of research in the field, two, or even three, authors could not deal with the task of preparing such a monograph. Therefore, they and Carlos A. Murillo invited 11 chemists, all with hands-on research experience, to contribute to a multi-authored volume. The 3rd edition, dedicated "to all of our past and present co-workers", features 14 co-authors, including the editors. They all work in American university or government laboratories, and six of them hail from Texas A & M University, where Cotton worked since 1972.

Each chapter is intended to be comprehensive, if not encyclopedic. The contributors tried to mention all the pertinent literature references, although the extent of the emphasis accorded to each article necessarily varies. Since the literature is now so voluminous, several topics that might have been included (or were included in the 2nd edition) have been omitted, or were dealt with in only limited detail, e.g., the treatment of metal–metal bonding in edge-sharing and face-sharing bioctahedra, and metal cluster compounds of rhenium. Also, the immense field of catalysis by dirhodium compounds has been restricted to the area of chiral catalysts.

Physical properties and bonding of many compounds are described in two places in the book. Some specific reports on compounds of certain metals are found in the first 15 chapters, whereas comprehensive discussions that are not specific to particular elements are given in Chapter 16. A 14-page list provides a selection of the less common abbreviations used in the book. As the volume is organized by element (or group of elements) and each chapter is divided into numerous sections and subsections, including extensive tables, the 10-page table of contents plays the part of an index to a major extent. The eight-double-column-page index is thus limited to general topics and concepts that occur often throughout the book, and in most cases individual compounds are not listed there.

The following list of the 16 chapters, together with their number of references and pages, should be useful to owners of previous editions who contemplate purchasing the latest edition: Introduction and Survey (66 references, 21 pp); Complexes of the Group 5 Elements (36, 11); Chromium Compounds (119, 34); Molybdenum Compounds (597, 114); Tungsten Compounds (150, 19); $X_3M{\equiv}MX_3$ Compounds (278, 48); Technetium Compounds (81, 19); Rhenium Compounds (438, 106); Ruthenium Compounds (216, 54); Osmium Compounds (71, 16); Iron, Cobalt and Iridium Compounds (52, 18); Rhodium Compounds (845, 125); Chiral Dirhodium(II) Catalysts and their Applications (200, 42); Nickel, Palladium and Platinum Compounds (221, 35); Extended Metal Atom Chains (86, 38); Physical, Spectroscopic and Theoretical Results (425, 90).

*Multiple Bonds between Metal Atoms* is among the more than 150 new chemistry books per year made available in electronic format in the Springer eBook Collection, which currently consists of more than 12000 books and is accessible at http://springerlink.com/books. Designed to provide instantaneous, convenient access to

book content, wherever and whenever needed, it is hyperlinked through easy-to-use browsing and search functions, is searchable on book chapter level, and is integrated with Springer Online Journals.

The 3rd edition of *Multiple Bonds between Metal Atoms* deals with one of the most active fields of inorganic chemistry, which comprises all but two of the d-block transition metals in Groups 5–10. It presents an extensive, critical review and discussion of preparations, reactions, bonding, and physical properties of more than 4000 compounds with metal–metal bonds of orders 0.5 to 4, and about 2500 references. I heartily recommend it to inorganic and materials chemists, and to all scientists concerned with the synthesis, spectroscopy, and structures of transition-metal compounds. It also belongs in academic, industrial, and government research libraries.

*George B. Kauffman*
California State University
Fresno, CA (USA)

**DOI: 10.1002/anie.200585495**

## *Sequence-specific DNA Binding Agents*


Edited by *Michael Waring*. Royal Society of Chemistry, Cambridge 2006. 258 pp., hardcover £ 79.95.—ISBN 978-0-85404-370-5

Most drugs are now designed to target specific proteins, and that principle will continue in the future. However, another major class of biological molecules, nucleic acids, has also attracted considerable attention as a source of potential targets for drugs. Of two important subclasses of nucleic acids, DNA and RNA, the latter looks much more attractive as a candidate for sequence-specific targeting, since it exists in the cell predominantly in single-stranded form. As a result, individual nucleobases are accessible for interaction with drugs. In contrast, DNA exists in the cell predominantly in duplex form, where bases are buried inside the double helix and are much less accessible for interaction with drugs. So the sequence-specific targeting of DNA, which is the theme of this book, presents the greatest challenge from the viewpoint of drug design. In recent years it has become evident that DNA-binding drugs are extremely important for medicine, as the mechanisms of action of chemotherapeutic drugs that were discovered by empirical means were progressively unraveled. DNA is now seen as the primary target for the most potent chemotherapeutic drugs. Therefore, the subject of this book is of great significance.

There is an enormous variety in the specific mechanisms of action of DNA-binding agents, and many of them operate not by themselves but in conjunction with various proteins working on DNA in the cell. Consequently, in many cases the description of the mechanism of action of the drug presents a fascinating story that involves the triangle DNA/drug/protein. Some of these stories are narrated in this volume. Of course, not all the stories on the subject are told (nobody can embrace the unembraceable), and not all the stories in the book are equally compelling, but the fact is that I found it difficult to put the book down.

The chapters that I found most entertaining and inspiring were those in which the authors not only tell the scientific story behind the discovery but also narrate, in a very vivid style, the history of the discovery. This is especially true for two adjacent chapters, one by S. Neidle and the other by D. Sun and H. Hurley. These are devoted to a new class of potential anticancer drugs, which bind specifically to G-quadruplexes. The cell targets for these drugs are single-stranded telomeric tails, which are always present at the 3′ ends of chromosomal DNA. The repetitive sequence of these single-stranded tails (TTAGGG) is such that they can fold back on themselves to form a very unusual DNA structure known as a G-quadruplex. Telomeric tails serve as primers for the enzyme telomerase, which extends telomeric sequences in cancer cells, thus making them immortal. By stabilizing the form of the G-quadruplex, the G-quadruplex-binding drugs deny telomerase any contact with the primer, thus potentially preventing cancer cells from perpetual division. The G-quadruplex-specific drugs present a fascinating example of drugs that recognize an unusual DNA structure rather than a specific sequence. Of course, for DNA-binding drugs it is a special case based on the fact that the telomeric ends are in single-stranded form.

A more common situation, which is discussed in most other chapters in the volume, is that of sequence-specific binding to the regular duplex DNA, which adopts the canonical B form. Enormous efforts and real ingenuity have been exercised to develop numerous classes of drugs that recognize duplex DNA in a sequence-specific manner. Since, in the B form of DNA, the bases are buried within, one possibility for sequence-specific recognition is to "search" DNA from one of the two B-DNA grooves. This is exactly what triplex-forming oligonucleotides (TFOs) do, as described in the chapter by D. A. Rusling, T. Brown, and K. R. Fox. Unfortunately, the prospects for any therapeutic applications of TFOs are not bright, for a number of reasons, mainly because long homopurine tracts are needed for stable binding of TFO to DNA. Such long tracts are scarce in sensible genomic sequences.

With regard to possible applications as a drug, peptide nucleic acid (PNA) looks much more attractive, as P. E. Nielsen, a PNA pioneer, indicates in a short but very informative chapter. The neutrality of the PNA backbone results in the two short homopyrimidine PNA oligomers forming exceptionally stable complexes with the corresponding homopurine sequences in one of the two DNA strands. The complex is so stable that PNA oligomers exhibit a unique ability to form strand-displacement complexes with duplex DNA, in an exceedingly sequence-specific manner. As a result, PNA has proven to be a remarkable tool for targeting duplex DNA.