Gold—Progress in Chemistry, Biochemistry and Technology

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This book is a collection of 21 specialist chapters describing recent progress in gold technology (nine chapters), biochemistry (one) and chemistry (11). For various reasons, metallurgical aspects, theoretical chemistry, and physics and solid-state chemistry were excluded. It is a pity that a chapter on the influence of relativistic effects on gold chemistry was not available.

Because of my own interests, I turned to Chapter 10 first, 'The biochemistry of gold' by Shaw. This provides an excellent overview of recent advances, including the role of gold–protein complexes, generation of $[Au(CN)_2]^-$ (a potentially active metabolite of gold antiarthritic drugs) and gold(III) (perhaps the cause of toxic side reactions) *in vivo*. Shaw points to possible future developments concerning gold anticancer and anti-HIV agents. Clearly there is still much important mechanistic gold biochemistry to be done.

In Chapter 11, Strähle reviews gold(I) and gold(III) compounds with bonds to nitrogen. This is an informative and readable chapter. The mysteries of the chemistry of the highly explosive yellow solid formed by addition of ammonia to $HAuCl_4$ or gold(III) oxide (so-called 'fulminating gold') still remain. The structures and properties of N-centred gold clusters such as $[(Ph_3PAu)_5N]^{2+}$ (stabilized by aurophilic Au–Au bonding, and elegantly studied by the editor of this book) are discussed.

One of the editor's two chapters is on organogold chemistry (Chapter 18). This is an excellent comprehensive survey of nearly 100 pages with 489 references, and covers gold(I) complexes [RAuL], those with two Au–C bonds, gold(I), gold(II) and gold(III) complexes with ylide ligands, gold(III) complexes with 1–4 Au–C bonds, homo- and hetero-metallic Au clusters, and the synthesis and properties of alkyne–gold complexes. This area has developed rapidly in recent years and the presence of short Au–Au contacts in organogold(I) complexes is common. Oxidative addition to dinuclear bis(ylide) complexes gives rise to unusual bicyclic gold(II) compounds containing a discrete transannular Au–Au bond. Auration of aromatic rings to give monoaryl gold(III) species can be readily achieved. As noted by Puddephatt in Chapter 9 ('Gold metal and gold alloys in electronics and thin film technology'), organogold complexes are attractive precursors for chemical vapour deposition (CVD) of gold, often alkyl–, vinyl– or alkynyl–gold(I) complexes [R–Au–L], but also organogold(III) such as $[Me_3Au(PMe_3)]$. He also describes briefly the important area of self-assembled, oriented monolayers of alkylthiols on clean metallic gold surfaces with potential applications in microfabrication and microelectronics.

A fascinating property of many compounds with Au–Au interactions of less than 3.6 Å is their luminescence. In Chapter 21 (spectroscopic methods), Bowmaker discusses whether the likely absorption transition is ligand-to-metal charge transfer or a metal-centred $5d \rightarrow 6p$ transition. The phenomenon of 'solvoluminescence' is fascinating: colourless crystals of the cyclic trigold complex $[Au_3(CH_3OC{=}NCH_3)_3]$, previously irradiated with ultraviolet light, emit bright flashes of yellow light on contact with chloroform or acetone (the work of Balch and co-workers). Bowmaker points out that the only ^{197}Au NMR signals observed to date are for the metal and its alloys, although the solid-state ^{31}P NMR spectrum of chelated tetrahedral gold(I) bisphosphine complexes can exhibit four-line patterns due to $^1J(Au–P)$ spin–spin coupling.

In Chapter 15 Dyson and Mingos take us from the stable dimeric unit Au_2 (dissociation energy 228 kJ mol^{-1} in the gas phase) through small clusters such as $[Au_7(PPh_3)_7]^+$ to the giant $[Au_{39}(PPh_3)_{14}Cl_6]^{2+}$, and to colloidal gold itself. If you are interested in metallic gold, then there are chapters on alloys for dental and electromechanical use, ceramic decoration [which uses gold(I) thiolates similar to antiarthritic drugs], refining and recycling, jewellery (for which hardening by alloying is essential), coinage and mining.

As the editor says in his opening sentence, 'Gold is a lovely subject for everyone', but will everyone be able to afford to read about it? Unfortunately, at this price, access to the book will be highly restricted. Few individuals will be able to buy it and probably not many libraries either. Let us hope that the publishers can think of a way of making such excellent material more widely available.

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Pharmaceutical Excipients Drugs and the Pharmaceutical Sciences, Vol. 94

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For those involved in pharmaceutical analysis and formulation, the *Drugs and the Pharmaceutical Sciences* series from Marcel Dekker has provided superb reference material since its launch over 20 years ago. *Pharmaceutical Excipients*, the 94th title in the series, continues this line of highly specialized reference works and provides in one easy-to-use volume, valuable spectroscopic information on 300 excipients most commonly used in drug formulation and production. There is no shortage of

spectroscopic data from chemical and analytical companies such as those from Nicolet, Aldrich and Sigma, but this is the first single reference work devoted entirely to pharmaceutical excipients.

The purpose of this volume is to provide IR, Raman and NMR (mainly ^{13}C) spectroscopic data on pharmaceutical excipients (many of which are also used as food additives) such as lubricants, plasticizers and dispersants. Previous excipient analyses have focused more generally on their bulk and particulate properties and have provided few, if any, molecular data. One of the most well-known textbooks in this field, the *Handbook of Pharmaceutical Excipients*, presents no molecular spectroscopy information at all.

The three introductory chapters deal with the theory behind vibrational spectroscopy and NMR spectroscopy and then discuss the practical application of these methods, especially solid-state NMR, to pharmaceutical analyses, describing how these spectra are obtained. The authors, both practising pharmaceutical analysts, have set out the rest of this textbook of spectral data, in alphabetical order of the generic name of each excipient. Data for each excipient are presented as a two-page section which clearly presents the chemical name of the excipient, its CAS registry number, its other names including trade and proprietary names, excipient class, molecular weight and structure (where applicable) as well as NMR, IR and Raman spectra, providing peak listings where appropriate. Two appendices provide a summary of characteristic Raman and IR frequencies in addition to chemical shift values for NMR spectroscopy.

Very few organometallic compounds are used as pharmaceutical excipients. Some notable examples, however, include the organosilicon polymers, dimethicone, used as an antifoaming agent and water repellent, and simethicone, used as an antibloating agent. Nevertheless, this book will be of value to anyone in the pharmaceutical industry involved in formulating organometallic compounds. It will also be of interest to pharmaceutical analysts and forensic scientists involved in drug analyses. This volume is certainly a worthy addition to the superb *Drugs and the Pharmaceutical Sciences* series.

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Advanced Inorganic Chemistry
F. Albert Cotton, Geoffrey Wilkinson, Carlos A. Murillo and Manfred Bochmann

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xv + 1353 pages. £58.50
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The new edition of this well-known textbook breaks fresh ground on several counts. The number of authors has been expanded and an expert, Russell N. Grimes, has been drafted in to write the chapter on boron chemistry. These developments bring a certain vigour to the text, together with something of a change in emphasis. This is particularly apparent in the treatment of organometallic chemistry, aspects of which now feature much more prominently. In addition there has been considerable reorganization of the material, with many of the topics which were discussed in the 'Survey of Selected Areas' section of the 5th edition now appearing under the chemistry of the appropriate elements in the new edition.

As with earlier editions, the book opens with a section on 'general principles'. Some of the topics dealt with here have naturally been carried over from previous editions, and are unsurprising and predictable: structures of coordination and cluster compounds, and classification of ligands. Others are a welcome addition and recognition that inorganic chemistry has moved on since publication of the 5th edition in 1988: fluxionality, and isoelectronic and isolobal principles. At the same time others are rather esoteric: bond stretch isomerism, zintl compounds, and chemical vapour deposition. Notable by its omission from the introductory material in this edition is a discussion of the structures of ionic solids.

The majority of the book is organized as in previous editions, with the descriptive chemistry of the elements dealt with in two parts: main-group elements in *ca* 580 pages, and transition elements in *ca* 530 pages. The coverage of these is as comprehensive as in earlier editions and for many elements includes substantial updating of the content. For example, in the discussion of the chemistry of hydrogen there are new sections on η^2-dihydrogen complexes and agostic interactions, and of course for carbon there is discussion of the fullerenes. The new chapter on boron provides a useful overview of the chemistry of boranes, carboranes and metalloboranes and has benefited greatly by being written by an author who is a specialist in the area.

The introduction to the section of the book which deals with the transition-metal elements is very different from that found in earlier editions. Previously this had largely focused on spectroscopic and magnetic properties; in the new edition the focus is on the bonding of ligands to transition metals. While much of the content of the following chapters is not new, there is considerable reorganization of material. For example, the biochemistry of iron now appears in the appropriate chapter rather than being dealt with in isolation as a 'selected topic'. While much of the material in the chapters on the lanthanides and actinides is similar to that in the previous edition, this does not hold true for the organometallic chemistry of the actinides, where a considerable amount of new, well-referenced, material is described.

The real innovation in this edition is the inclusion of Part 4, 'The role of organometallic chemistry in catalysis', (*ca* 130 pages), by Manfred Bochmann. The section comprises two chapters: 'Fundamental reaction steps of transition metal catalyzed reactions' and 'Homogeneous catalysis by transition metal complexes'.