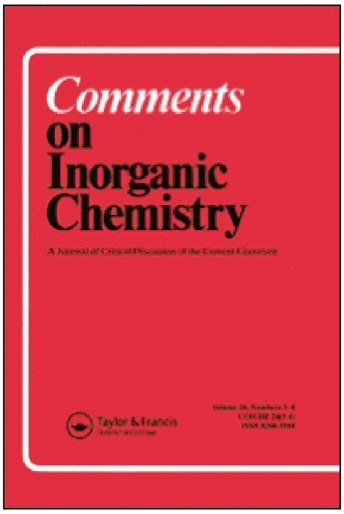

Comments on Inorganic Chemistry
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713455155

A SYNOPSIS OF THE CAREER OF PROFESSOR F. GORDON A. STONE, CBE, FRS

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To cite this Article Hodson, Bruce E.(2010) 'A SYNOPSIS OF THE CAREER OF PROFESSOR F. GORDON A. STONE, CBE, FRS', Comments on Inorganic Chemistry, 31: 3, 64 — 70
To link to this Article: DOI: 10.1080/02603594.2010.517472
URL: http://dx.doi.org/10.1080/02603594.2010.517472

Comments on Inorganic Chemistry, 31: 64–70, 2010
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ISSN: 0260-3594 print
DOI: 10.1080/02603594.2010.517472

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A SYNOPSIS OF THE CAREER OF PROFESSOR F. GORDON A. STONE, CBE, FRS

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INTRODUCTION

In May 2010, Baylor University hosted the F. Gordon A. Stone Symposium, recognizing Gordon's two decades of academic service to the university, and a remarkable scientific career spanning over 60 years. The list of speakers boasted an international assortment of some of the most significant figures in organometallic and inorganic chemistry from the last 50 years, each of whom was in some way academically related to Gordon, either through direct employment, collaboration, or simply a deep respect for his research.

The details of Gordon's career have been beautifully described by Anthony Hill and Peter Maitlis in a special edition of Inorganica Chimica Acta,[1a,b] and in one volume of the ACS "Profiles, Pathways, and Dreams" series,[1c] humorously entitled "Leaving No Stone Unturned: Pathways in Organometallic Chemistry." By way of introduction to this edition of *Comments on Inorganic Chemistry*, which contains summaries of work presented at the Symposium, a brief and necessarily parsimonious outline now follows.

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Figure 1. Professor F. Gordon A. Stone, July 2010, Waco, Texas.

EDUCATION AND THE HARVARD YEARS

Gordon was the first scientist in the U.K. to study the chemistry of the boranes, as part of his doctoral studies at Christ's College, Cambridge, under Harry Emeléus. This experience solidified his desire to remain in academia, and on completion of his Ph.D. in 1952 spurred him on to postdoctoral positions in the U.S., first at the University of Southern California with Anton Burg (under the Fulbright program) and then with Gene Rochow at Harvard in 1954. After only six months at Harvard he became an instructor of chemistry (and eventually, in 1956, assistant professor), which introduced him to undergraduate teaching, and permitted him independent research.

Gordon's initial studies at Harvard focused on adduct formation by the Lewis acids BX_3 ($X = H, F, Me$),[2] however he was later inspired by the burgeoning field of organometallic chemistry, soon after the publication of X-ray crystallographic determinations of ferrocene by subsequent Nobel Laureates Geoffrey Wilkinson [3] and E. O. Fischer.[4] Hence, the Stone research group began investigations into the coordination of unsaturated organic molecules to transition metal atoms. Several significant reports followed, notably concerning the coordination of cyclooctatetraene to iron,[5] the preparation of a neutral η^7-cycloheptatrienyl η^5-cyclopentadienyl

Figure 2. Stone Symposium Speakers. Left to right, back row: Patrick Farmer, Thomas D. McGrath, Tony Hill, Peter Maitlis, R. Bruce King, John Fackler, Alan Cowley, Ian Manners. Front row: Larry F. Dahl, Fred Hawthorne, Judith A. K. Howard, F. Gordon A. Stone, Marcetta Darensbourg, Malcolm Chisholm, Malcolm Green.

vanadium(0) sandwich complex,[6] and the first demonstration of an allyl ligand converting between η^1- and η^3- coordination modes.[7] Concurrently, work began on the synthesis and characterization of transition metal complexes involving sigma bonded perfluoroalkyl ligands, which Gordon refers to as "how he became famous." These studies included early examples of metallacycles, which would lead others towards our modern interpretation of mechanism in both oxidative addition and insertion reactions.

THE BRISTOL YEARS

In 1962, after a total of 8 years at Harvard, Gordon returned to the U.K. as a member of the faculty at Queen Mary College (QMC) of the University of London. One year later he accepted the first chair of inorganic chemistry at Bristol University, where he was to remain for the next 27 years.

During the time immediately after leaving the U.S., the Stone research group continued investigations into transition metal complexes involving fluorocarbon ligands, broadening their studies to include perfluoroaromatics.[8] Significant advancement was also given to the chemistry of ruthenium carbonyl clusters, after an initial breakthrough provided a high-yield synthesis of $[Ru_3CO_{12}]$.[9] In addition to the preparation and reactivity studies of hydride derivatives of this compound, a number of species containing group 14 elements were reported, including a stable diruthenium complex containing a highly unusual bridging pentalene ligand.[10]

Inspired by Hawthorne's recognition of the similar abilities of the $[\textit{nido}\text{-}C_2B_9H_{11}]^{2-}$ and ubiquitous $[C_5H_5]^-$ anions to coordinate to transition metal atoms, Gordon's attention later turned to the preparation of metallacarboranes, an area in which he remains active to this day. The syntheses involved introduction of a transition metal vertex into a sub-icosahedral *closo* carborane cage *via* oxidative insertion.[11] Interest in the preparation of suitable metal fragments led to a facile synthesis of the versatile platinum(0) compounds $Pt(C_8H_{12})_2$, $Pt_3(^tBuNC)_6$, and $Pt(C_2H_4)_3$,[12] the latter in particular serving as the source of a multitude of derivatives due to the lability of the ethylene ligands. Such electron-rich compounds later afforded a wide range of mixed-metal clusters through reaction with electron deficient transition metal complexes.[13]

In the late 1970s, the Nobel prize-winning isolobal analogy of Roald Hoffman [14] led Gordon to reconsider the reactions of Fishcher and Schrock transition metal carbene and carbyne complexes with low valent transition metal fragments. Contemplation of these reactants in terms of their isolobal organic relatives allowed him to formulate a systematic methodology for the synthesis of metal-containing analogues of common organic frameworks.[15]

Hoffman has referred to Gordon's intuitive synthetic strategies as his "magic skill," and also commented "what has always impressed me is how you [Stone] could know ahead of time what the theoreticians could later come up with!.[1a,c]"

In his latter years at Bristol, in addition to serving two four-year stints as head of the chemistry department, Gordon served on a number of national committees designed to assess the status of chemistry in Britain, and strongly advocated the funding of fundamental research in the core subject of chemistry. In recognition of this, and his contributions to science, he received a CBE in the Queen's Birthday Honors list on his U.K. retirement in 1990. Also during his time at Bristol, he was elected to the Royal Society. Together, these awards allowed him the personalized number plate "CBE FRS" during the next stage of his career.

THE BAYLOR YEARS

Gordon chose not to stop his research at the mandatory British retirement age of 65, feeling that he "had the tiger by the tail," and so instead relocated to Texas, becoming the Robert A. Welch Foundation Distinguished Professor of Chemistry at Baylor University. He has described this position as "having fun with some postdocs," as the Welch Foundation gave him free rein in choice of research topic, and did not stipulate the mentoring of graduate students (though he continued to do so).

He has remained a prolific publisher, with over 120 journal articles co-authored since his arrival. Initial reports echoed his earlier work at Bristol on the preparation of poly-metallic complexes from carbene or carbyne species, however the precursors now incorporated a dicarborane ligand, $[nido\text{-}C_2B_9H_{11}]^{2-}$, which provided several new avenues of investigation. With its hydridic {B–H} units, the presence of the "non-innocent" carborane cage led to mixed-metal compounds containing $B - H \rightharpoonup M$ agostic type interactions or direct B–M bonds (where M is an exo-polyhedral transition metal atom).[16] The higher negative charge on the $[nido\text{-}C_2B_9H_{11}]^{2-}$ ligand in comparison with cyclopentadienide (used in numerous earlier studies) in many cases afforded anionic products. Subsequent addition of suitable cationic transition metal fragments to these often resulted in zwitterionic compounds.[17] In later work, functionalization at the carborane {B–H} vertices was also explored.[18]

Most recently, the focus of Gordon's studies has turned to the transition metal chemistry of monocarborane clusters, initially with the logical progression from species containing the $[nido\text{-}C_2B_9H_{11}]^{2-}$ ligand to the isolobal $[nido\text{-}CB_{10}H_{11}]^{3-}$, and finally to clusters with less than 11 vertices.[19] Preparation of compounds involving the latter have typically involved reaction of a zero valent transition metal fragment with a *closo* monocarborane cage, drawing upon "cluster expansion" reactions done in the 1970s.[11] Once formed, these species are typically anionic, and again have afforded a wide array of mixed-metal species through reaction with sources of cationic transition metal fragments.

Gordon's contributions to Baylor extend far beyond his list of publications. Many years as a synthesis-based researcher have made him acutely aware of the necessity of having easy access to cutting-edge analytical equipment. His acceptance of the Welch Chair was thus contingent upon the acquisition of an X-ray diffractometer and an upgrade of the NMR facilities in the Baylor chemistry department. In 2004, the

Baylor School of Arts and Sciences relocated to a new $102 million building, the Welch Chair laboratories of which were designed by Gordon and his co-workers. He has been instrumental in attracting world class speakers and researchers to Texas through chairmanship of the Gooch-Stevens Lecture series organization committee, and in the hiring of more than 30 international postdoctoral workers. Gordon's colleagues at Baylor have repeatedly benefited from his years of experience in academia and encyclopedic knowledge of the organometallic literature.

In his own research group (where he is affectionately known as "Prof") Gordon introduced the British tradition of "teatime," an informal discussion period *cum* group meeting. As well as the generation of new research ideas, these sessions illustrated his endless ability to entertain and inspire through his quick wit, amusing anecdotes, and poignant observations regarding global current affairs. While Gordon's gruff demeanor can be intimidating, those close to him know that this façade covers a heart of gold and a deep paternal concern for his academic family. In his own words, "I am a Pussycat." Many of those privileged to have worked with him over the years can attribute varying degrees of success in their careers to his generous advice, support, and friendship.

THE FUTURE

At the time of writing Gordon has authored over 750 journal articles; he remains one of the most-cited inorganic chemists in the world, with a Hirsch index of 72. He insists that his greatest scientific legacy are the more than 200 students and postdoctoral workers he supervised over a 57-year period, a large percentage of whom are now highly successful both in the academic and industrial arenas worldwide.

Gordon's retirement in 2010 marks the end of a 20-year period at Baylor, and 60 years since his first scientific publication.[20] As Emeritus Professor of Chemistry he will retain his laboratory and office, which in addition to his enduring and infectious passion for novel organometallic compounds ensures that his influence will continue to be felt for years to come.

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