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

SOME EARLY-DAYS MEMORIES AND THEN A SMALL DIVERSION INTO BORON CHEMISTRY, AND FINALLY SOME NEW CHEMISTRY OF CARBON NANOTUBES

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Online publication date: 25 November 2010

To cite this Article Green, Malcolm L. H.(2010) 'SOME EARLY-DAYS MEMORIES AND THEN A SMALL DIVERSION INTO BORON CHEMISTRY, AND FINALLY SOME NEW CHEMISTRY OF CARBON NANOTUBES', Comments on Inorganic Chemistry, 31: 3, 90 — 94
To link to this Article: DOI: 10.1080/02603594.2010.517504
URL: http://dx.doi.org/10.1080/02603594.2010.517504

Comments on Inorganic Chemistry, 31: 90–94, 2010

ISSN: 0260-3594 print
DOI: 10.1080/02603594.2010.517504

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SOME EARLY-DAYS MEMORIES AND THEN A SMALL DIVERSION INTO BORON CHEMISTRY, AND FINALLY SOME NEW CHEMISTRY OF CARBON NANOTUBES

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A brief personal account of the relation of the author with Professor Gordon Stone is described. Then the two parts of the scientific presentation of the symposium talk is given.

The first part shows that there are two classes of two-electron three-centre bonds. And the manner in which the se two types of bonds differ in their interaction with each other is shown. For example in the Class II 2e-3c bond the central bridging atom formally contributes two electrons to each of the other two atoms, in terms of electron counting considerations.

The second part describes how carbon nanotubes, decorated with sugar molecules on the outside and filled with radioactive iodine, sealed in the interior of the SWNTs can be delivered selectively to the lungs of a mouse.

The radio nuclei are selectively located in exceptionally high concentrations and this has implications for applications in radio surgery.

RELATIONS WITH PROFESSOR F. G. A. STONE, CBE, FRS

Geoffrey Wilkinson came to Imperial College in 1957 and he accepted me as a Ph.D graduate student with the start date of September of that year.

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It was exceptionally fortunate that I had chosen to work in the field of organometallic transition metal chemistry, which was to become the fastest growing and, probably, the most exciting area of inorganic chemistry for the next two decades or more. Wilkinson's group was the first transition metal organometallic group in the UK and at that time the only other competitor in the field was the group of Professor E.O. Fischer in Munich.

Some of the early history of those days has been delightfully elaborated in the recent book by Professor Helmut Werner[1], who was one of Fischer's earliest research students. The competition was intense and stimulating and many advances, especially in cyclopentadienyl metal chemistry, were made at that time. My first publication was on bis-p-cyclopentadienyl rhenium hydride and contained the first ^{1}H NMR spectrum of a transition metal hydride which showed the characteristic high field shift.

Within a year or two papers from the new research group of Gordon Stone at Bristol appeared. I recall papers in 1959 with T.A. Manual on iron carbonyl and cyclooctatetraene and cycloocta-1,5-diene with tungsten tetracarbonyl.

In 1960, the first π-allyl compounds was prepared by Gordon with co-authors H. D. Kaesz and R. B. King. It was quite a while before I met Gordon, probably at a meeting somewhere, but I came to know him first through his work and later by meeting not only Gordon, but also his students such as Bruce King, Herb Kaesz, and many more over the years. I recall that we all got along together very well and we did not share the rather fierce competitive pressure that existed between, for example, Wilkinson and his competitors such as Fischer and Gordon Stone.

Over the last forty years I have followed the chemistry of the Bristol School established by Gordon and as the field expanded we all found different paths to develop on our own. For this reason I rarely found myself working in an area close to that of Gordon.

The Bristol School of organometallic chemistry and, more generally, inorganic chemistry is now high in the "first division" of British inorganic chemistry and there is no doubt that the credit for this belongs to Gordon. His passion for chemistry was infectious and is manifest even now by his clear reluctance to retire.

SUMMARY OF SYMPOSIUM PRESENTATION

My talk at the conference began with a brief survey of the key people at the earliest days to the development of the organometallic chemistry of

the transition metals. There were many photo portraits of the most prominent people, many of who are still active. This showed how early in this subject Gordon Stone's group appeared at Bristol University and how subsequently Bristol University Chemistry has continued to develop into the internationally recognized school that it now constitutes.

In the second part of my talk I briefly described some thoughts abut how there are two classes of two-electron three-center bonds (2e-3c) in chemistry and I explained how the different modes of bonding are represented in the covalent bond classification method. The two classes of bonds are shown in Figure 1.

Finally, I described some recent work of the chemistry of carbon nanotubes. In particular, our most recent discovery that single wall

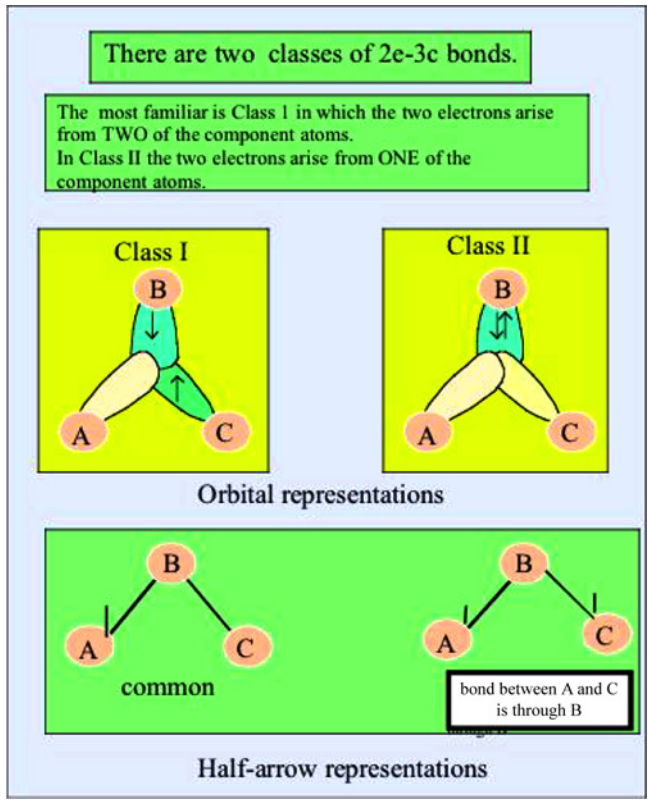

Figure 1. The two classes of two-electron three-center bonds (2e-3c). (Figure appears in color online.)

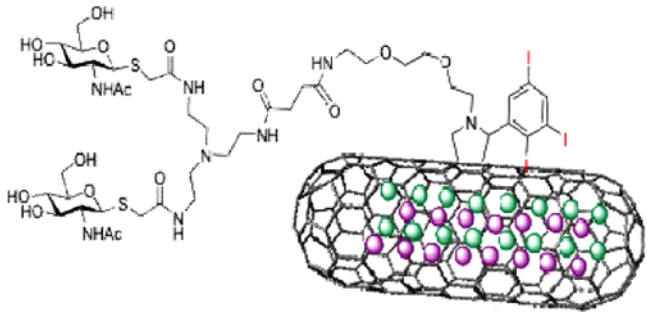

Figure 2. Glysosylated-Na^{125}I@SWNT. (Figure appears in color online.)

carbon nanotubes (SWNTs) which have been filled with the radioactive Na^{125}I and also have with sugar molecules covalently attached to the outside of the SWNT walls (see Figure 2). These could be dispersed in water and the dispersions when injected into mice become selectively located in the lungs and nowhere else.

Detailed experiments showed that there was no leakage of the radioactivity from the lungs even after one week and due to this selectivity

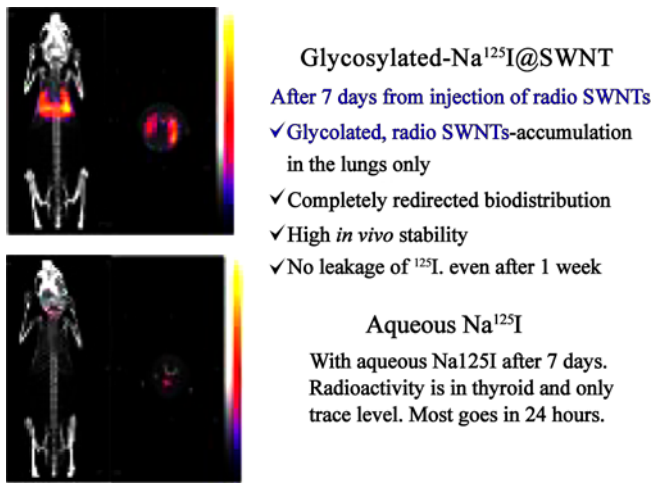

Figure 3. Whole-animal SPECT/CT images of mice treated with glocosylated SWNTs filled with radio iodine (NA^{127}I). The upper image shows that the radio iodine is still specifically located in the lungs of the mouse, even after 7 days. The lower image shows that most of the radio iodide has departed from the body of the animal. (Figure appears in color online.)

and stability, the radio dosage was greatly higher than has ever been previously achieved, for example, in the use of ^{125}I in the thyroid. Figure 3 shows SPECT data for a mouse treated with the glycosylated–coated –Na^{125}I@SWNT and, for comparison a mouse treated with the same dose of Na^{125}I, using an aqueous solution of Na^{125}I I. In the latter case after seven days only traces of the radio iodine remain in the mouse, in the thyroid, which the dosage of the sample where the Na^{125}I within the sealed SWNTs is still clearly apparent (for a full account, see [3,4]).

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