J. M. Thomas

*The author presented on this page has published more than **35 articles** in Angewandte Chemie, most recently:*
"Intellectual Freedom in Academic Scientific Research under Threat": J. M. Thomas, *Angew. Chem.* **2013**, *125*, 5764–5765; *Angew. Chem. Int. Ed.* **2013**, *52*, 5654–5655.

Sir John Meurig Thomas

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Career:
1951–1954 BSc, University College of Wales, Swansea
1954–1957 PhD supervised by Keble Sykes, University College of Wales and Queen Mary College, University of London
1958 Scientific Officer, UK Atomic Energy Authority
1958–1969 Assistant Lecturer (1958), Lecturer (1959), Senior Lecturer (1964), Reader (1965), University College of North Wales (UCNW), Bangor
1969–1978 Professor and Head of Department of Chemistry, University College of Wales, Aberystwyth
1978–1986 Head of Department of Physical Chemistry, University of Cambridge, and Professorial Fellow, King's College, Cambridge
1986–1991 Director of the Royal Institution (RI) of Great Britain, London, and Director of the Davy–Faraday Research Laboratory
1988–1994 Fullerian Professor of Chemistry at the RI
1993–2002 Master (Head) of Peterhouse (College), University of Cambridge

Awards: **1989** Faraday Medal, Royal Society of Chemistry (RSC); **1992** Messel Gold Medal, Society of Chemical Industry; **1994** Davy Medal, The Royal Society; **1995** Willard Gibbs Gold Medal, American Chemical Society (ACS); **1999** ACS Annual Award for Creative Research in Heterogeneous and Homogeneous Catalysis; **2003** Linus Pauling Gold Medal, Stanford University; **2004** Giulio Natta Gold Medal, Italian Chemical Society; **2005** Sir George Stokes Gold Medal, RSC; **2010** Gerhard Ertl Lecture Award, Fritz Haber Institute of the Max Planck Society; **2011** Kapitza Gold Medal, Russian Academy of Natural Sciences

Current research interests: Working on the premise that in catalysis (unlike particle physics) it is easier to generate new information than to rationalize knowledge already won, I decided to concentrate on writing university text books and review articles and also on giving lectures on the frontiers of heterogeneous catalysis as well as on themes that popularize science. I still publish (with collaborators) a few original research articles on single-site heterogeneous catalysts (SSHCs) and frontier electron microscopy, especially scanning transmission electron tomography. Two monographs (one with A. H. Zewail on 4D electron microscopy and another on the use of SSHCs in green chemistry and clean technology) have been published recently (2010 and 2012, respectively). For the past year, I have been engaged in completely revising the textbook *Principles and Practice of Heterogeneous Catalysis*, which was first published with W. J. Thomas in 1997. I also write at least one substantial historical-scientific review article per year. In the last five years I have given around fifty lectures per year, half on catalysis (my own, and others' work), the other half on popularization and cultural aspects of science.

Hobbies: Bird-watching, listening to classical music; reading poetry (English and Welsh) aloud in a solitary state; ancient civilizations; minerals

My greatest achievement has been … to combine being a teacher, a researcher, and a popularizer of science for over 50 years.

My worst nightmare is … to find myself dumbstruck when I am about to give a lecture.

The most exciting thing about my research is … its unending nature: there is always something new to discover.

My biggest motivation is … an amalgam of curiosity and enthusiasm.

I lose track of time when … I am writing a new lecture.

Guaranteed to make me laugh is … any film featuring Charlie Chaplin.

The best advice I have ever been given was … "read, read, read; write, write, write" (by the Head of University College, Swansea, when I was a 1st year undergraduate).

The worst advice I have ever been given was … "when in doubt, shout" (by a fellow lecturer at UCNW when I told him that I was nervous about giving my first lecture on statistical thermodynamics to the third-year undergraduates).

I can never resist … trying to pack as much science, music, and human interaction into each day as possible.

When I'm frustrated, I … go for a long, brisk walk.

My favorite author (fiction) is … Anton Chekhov, closely followed by Kazuo Ishiguro and John Steinbeck.

My top three films of all time are … "The Gold Rush" (starring Charlie Chaplin), "Kind Hearts and Coronets" (starring Alec Guinness), and "Only Two Can Play" (starring Peter Sellers and Mai Zetterling; set in Swansea, based on a novel by Kingsley Amis).

My favorite piece of music is … Schubert's "An die Musik", closely followed by "Die Taubenpost" (and almost all of Schubert's other songs).

My favorite quote is … when I am in a somber mood: "If a man will begin with certainty, he will end in doubts; but if he will be content to begin with doubts, he will end in certainties" (Francis Bacon). In a frivolous mood: "Nothing succeeds like excess" (Edwin Land).

The most significant scientific advance of the last 100 years has been … the determination of the structure of DNA, followed by the invention of the charge-coupled device.

The biggest problem that scientists face is … solving how to harness solar energy.

What I look for first in a publication is … is the introduction: why and how was the work undertaken?

The most important thing I learned from my parents is … to be straightforward and honest, and to work hard.

My favorite place on earth is … Florence (followed by Karnak).

I chose chemistry as a career because … it is *the* central subject, and the language of experimental science.

My best investment was … purchasing for £8 in 1959 a second-hand light microscope when my departmental grant was £50 per year.

How is chemistry research different now than at the beginning of your career?

The main difference is accessibility and instant retrieval of available information, old and new. When I began as a researcher, in 1958, looking mainly at the chemical consequences of defects in solids, I sedulously followed the premier chemical and physical journals. But I had to rely a great deal on the Inter-Library Loan Service run in the UK. It often took a week to receive a required paper or book. The Telex system eased matters in the early 1970s. But now, thanks to the internet, one can read a paper a few minutes after deciding to consult it. Other major differences have occurred on instrumental and computational fronts and in the availability of databases. The CCD has made my life easier in spectroscopic and electron-microscopic adventures. And packages of programs like the fast Fourier transform have eased experimental work greatly. On average, throughout my career, I have visited a chemistry library once a week. Now the periodicals shelves are bare, owing to online subscriptions. This is a pity, as my education owes a great deal to having read the paper next to the one I wanted to consult: this is much more difficult to do on a computer.

What is the secret to publishing so many high-quality papers?

Always endeavor to tackle interesting **and** important work. Also, try to describe it in ways that are memorable, or at least so as to convey the excitement that led one in the first instance to tackle the work that one is reporting. Always try to develop new techniques or deploy an unusual combination of them.

My 5 top papers:

1. "Design, Synthesis, and In Situ Characterization of New Solid Catalysts": J. M. Thomas, *Angew. Chem.* **1999**, *111*, 3800 – 3843; *Angew. Chem. Int. Ed.* **1999**, *38*, 3588 – 3628.
   This article, a summary of my lecture at the Karl Ziegler Centenary Celebrations at Mülheim (1998) and my Linus Pauling Lecture at Caltech (1999), describes how, by taking open-structure, microporous and mesoporous solids, one may controllably assemble single-site heterogeneous catalysts (SSHCs) that may be readily explored, in situ, with synchrotron radiation and other techniques (notably FTIR) so as to reveal the local atomic environment of the active center and, at the same time, explore the long-range order of the

matrix to which it is attached. SSHCs offer a strategy for the precise design of new catalysts. The SSHCs I describe in the paper encompass the reactions: aerobic oxyfunctionalization of terminal groups in linear alkanes; low-temperature selective aerobic oxidation of cyclohexane; radical-free epoxidation of alkenes; Bayer–Villiger oxidations of ketones; preferential dehydration of methanol to yield ethane and propene; and enantioselective allylic aminations. This article explains the key role that solid-state chemistry has to play in heterogeneous catalysis.

2. "Heterogeneous catalysts obtained by grafting metallocene complexes onto porous silica": T. Maschmeyer, F. Rey, G. Sankar, J. M. Thomas, *Nature* **1995**, *378*, 159–162.
   Herein we took advantage of the newly available large-diameter family of mesoporous silica, and the Si–OH groups on their inner surface, to prepare SSHCs, where titanol groups were shown (by in situ X-ray absorption and FTIR spectroscopy) to be tripodally grafted onto the silica. Using the technique of combining X-ray absorption and X-ray diffraction developed earlier with Neville Greaves, we could follow each single step of the formation of the $HOTi(SiO)_3$ active center and its subsequent behavior during epoxidation of cyclohexene with an alkylhydroperoxide. The oxidation state of titanium (Ti^{IV}) could be directly determined, as well as bond lengths and the expansion of the initial four-coordinated active center to a six-coordinated one during the steady-state epoxidation. Our in situ study revealed that the Eley–Rideal mechanism prevailed. We could also follow the gradual decay of the catalytic activity, and its regeneration; this was the first reported study to do so in quantitative detail. The preparation technique described herein is now extensively used by others. I am told that this paper is the most cited of all papers on heterogeneous catalysis published by *Nature*.
3. "Design of a 'green' one-step catalytic production of ε-caprolactam (precursor of nylon-6)": J. M. Thomas, R. Raja, *Proc. Natl. Acad. Sci.* **2005**, *102*, 13732–13736.
   This is a laboratory-based proof of principle that a benign solvent-free method exists (using air and ammonia in place of aggressive reagents, i.e., oleum and hydroxylammonium sulfate) for the production of ε-caprolactam. Moreover, there are no nasty by-products. In contrast, the favored industrial method forms almost four times as much ammonium sulfate as it does nylon-6. The latter product is formed by simply heating ε-caprolactam. It is readily recyclable, unlike nylon-6,6.
4. "Mechanistic Insights into the Conversion of Cyclohexene to Adipic Acid by H_2O_2 in the Presence of a TAPO-5 Catalyst": S.-O. Lee, R. Raja, K. D. M. Harris, J. M. Thomas, B. F. G Johnson, G. Sankar, *Angew. Chem.* **2003**, *115*, 1558–1561; *Angew. Chem. Int. Ed.* **2003**, *42*, 1520–1523.
   When a Ti^{IV} ion is incorporated into the framework of ALPO-5, it confers not only Lewis acidity but weak Brønsted acid activity to the catalyst. This bifunctionality makes it possible to carry out a cascade of catalyzed reactions in "one pot". Cyclohexene can now be routinely prepared (thanks to Japanese industry) from benzene. We set out (with Kenneth Harris) to investigate, using parallel ^{13}C and ^{1}H NMR and GC-MS analysis, the course of the benign conversion of the hexene to adipic acid, and were able to identify seven distinct intermediates, one of which (the *cis* diol, but not the *trans* diol), to our surprise, is formed by a free-radical mechanism.
5. "Sheet Silicates: Broad Spectrum Catalysts for Organic Synthesis": J. A. Ballantine, J. H. Purnell, J. M. Thomas, *J. Mol. Catal.* **1984**, *27*, 157–167.
   This paper describes the strategy and details of how, using acidic, synthetic montmorillonites, or beidellites, one may catalytically prepare a wide range of solvents and building blocks for fine chemicals, active pharmaceutical ingredients, and heavy chemicals (ethers, esters, amines, alcohols, and alkylated arenes). In particular, we outlined a one-step, solvent-free, 100% atom-efficient synthesis of ethyl acetate that involves the interlamellar addition of acetic acid to ethylene over our new solid-acid catalysts. A variant of this (patented) discovery is now the basis of the "green" industrial synthesis of ethyl acetate, on a 300000 tonnes per annum scale in the UK.

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