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My Research Connections with English Scientists over the Past Six Decades

Robert Cooper Liebermann

Mineral Physics Institute and Department of Geosciences, Stony Brook University, Stony Brook, NY, USA
Email: Robert Cooper Liebermann

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Abstract

Over the past six decades, I have maintained research connections with English scientists while pursuing an academic career focusing on scientific discoveries of the physical properties of minerals at high pressures and temperatures. During this period, I have also visited many research laboratories in England, including University of Cambridge, University College London, University of Oxford and the Atomic Weapons Research Establishment [AWRE] in Aldermaston, England. The objective of this paper is to relate this history.

Keywords

Mineral Physics, High Pressure, High Temperature, Synchrotron X-Radiation Facilities

1. Introduction

Over the past decade, I have concentrated on writing papers on my history pursuing a scientific career in mineral physics. Recently, I have published papers on my research connections with French, Czech, Chinese, Russian and German scientists in the International Journal of Geosciences [1] [2] [3] [4] [5]. This new paper on my English connections is of a similar genre; with apologies to my late Scottish friend Paul McMillan. Finally, I document my own English heritage back to the Mayflower in 1620.

2. Lamont Years 1964-1971

2.1. Seismology

In 1964, I commenced graduate studies at the Lamont Geological Observatory of Columbia University. My first research projects with Paul Pomeroy were focused

on detecting and discriminating underground nuclear explosions from natural earthquakes [6]. Among those events was Long Shot in 1965 beneath Amchitka Island in the Aleutians [7]. These studies were conducted in the framework of the threat of nuclear weapons and the necessity of success at negotiations of a test ban treaty.

Our work paralleled that at the Atomic Weapons Research Establishment in Aldermaston, England, which was directed by Hal Thirlaway, and also studied Long Shot. In 1968, I visited his team, including Peter Marshall and Alan Douglas, at the headquarters of the United Kingdom Atomic Energy Authority in Blacknest.

2.2. Mineral Physics

In 1967, I was encouraged by fellow grad students Art McGarr and Peter Molnar to shift the focus of my research from seismology to the new field of mineral physics, then being introduced to Lamont Geological Observatory by Orson Anderson [8]. Over the next 4 years, I conducted experiments on the sound velocities of minerals at high pressures and temperatures under the guidance of Edward Schreiber and worked under the supervision of Orson Anderson on several semi-theoretical papers; among those was one developing equations for the pressure derivatives of the elastic constants for three cubic lattices [9].

As part of my education in mineral physics, Anderson arranged for me to attend two conferences sponsored by NATO and convened by Keith Runcorn at the University of Newcaste-upon-Tyne in 1966 and 1968 and we subsequently published a paper in the conference volume edited by Professor Runcorn [10].

Dan McKenzie from the University of Cambridge visited Lamont for several months in 1971. There was considerable interest in this visit, especially in view of the fact that his paper with Robert Parker on plate tectonics had recently been published [11]. That work closely paralleled the work of Isacks, Oliver and Sykes [12] on "new global tectonics", which focused on the key observation of the occurrence of deep-focus earthquakes in the Tonga-Fiji region.

When I sent Dan a copy of the Anderson and Liebermann 1970 paper [9], he commented: "This is the first paper I have read that I wish I had written and published."

3. ANU Years 1971-1976

In 1970, I moved to Canberra, Australia and established the first mineral physics laboratory in Australia at the Australian National University [ANU] under the auspices of A. E. (Ted) Ringwood. Over the next 6 years, we published 25 research papers in peer-reviewed journals, many of them in collaboration with graduate students Ian Jackson and Leonie Jones. While, of course, no self-respecting Aussie would consider him- or herself "English," my family certainly felt the influence of English history and culture in Canberra.

4. Stony Brook Years 1976-2022

In 1976, I moved from the ANU to Stony Brook University to join the faculty of the Department of Geosciences [13]. Over the ensuing years, I have had extensive research connections with English scientists and universities.

4.1. University of Cambridge

One of the first connections between Stony Brook and Cambridge was through my faculty colleague Charlie Prewitt, who spent a sabbatical at Cambridge in 1975-76 to work with Desmond McConnell and his students, Michael Carpenter and David Price. Thus, while Ross Angel was working on his PhD at Cambridge with Andrew Putnis, David Price introduced him to Prewitt during the International Union of Crystallography congress in Hamburg in August 1984. After a visit to Stony Brook in January 1985, Ross won a NATO Research Fellowship to join Charlie Prewitt's group at Stony Brook to work in single-crystal diffraction. He arrived in October 1985. His main interactions with our high-pressure research activities were to help Nancy Ross in putting runs up on the girdle-anvil press for her synthesis of germanates, and to audit my graduate seminar on high-pressure techniques. Ross told me that this was the toughest course he had ever taken. Nonetheless Ross has continued to work in high-pressure mineral physics.

One of my most extended collaborations with English scientists was with Andrew Putnis, who was then on the faculty of the University of Cambridge, who later moved to the Geowissenschaften an der Westfälischen Wilhelms-Universität Münster with a joint appointment at Curtin University in Australia.

For twenty years from1985 to 2004, Putnis and I (and later Michael Hochella) edited a series of books on mineral physics and chemistry: Cambridge Topics in Mineral Physics and Chemistry. This series provides readable and readily accessible foundations on which current research in mineral physics and chemistry is based. The series covers a broad range of topics relating to the atomic structure of minerals, their physical and chemical properties and relationship to structure, phase transformations and kinetics, and spectroscopic and experimental techniques.

This book series included tomes authored by distinguished scientists from throughout the world, including many from England, including Paul McMillan who was clearly Scottish and thus not English, having been born in Edinburgh. Ekhard Salje was not English, originally from Leibniz University in Hanover, Germany, and now a dual citizen of Germany and Great Britain. Jean-Paul Poirier's book on Introduction to the Physics of the Earth's Interior was the first book in the series and also the most popular and the best seller in this series and was reprinted in 2000.

Other books in this series of books on Topics in Mineral Physics and Chemistry are:

Alex McLaren (1991): Transmission Electron Microscopy of Minerals and Rocks.

Martin Dove (1993): Introduction to Lattice Dynamics.

Roger Burns (1993): Mineralogical Applications of Crystal Field Theory.

Ekhard Salje (1993): Phase Transitions in Ferroelastic and Co-elastic Crystals.

Alex Navrotsky (1994): Physics and Chemistry of Earth Materials.

Catherine McCammon (2004): Mossbauer Spectroscoopy: Theory and Applications in the Earth Sciences.

Another student of Putnis at Cambridge who visited Stony Brook was Simon Redfern, who is now in Singapore. Simon's research covers a broad range of interests all linked by their relationship to the atomic-scale, nano-scale and microscopic structure of minerals. His work employs experimental methods in the lab using Raman spectroscopy and diamond anvil cell methods, and at national Synchrotron and Neutron radiation facilities. He augments these studies with computational modelling of mineral structure and properties at extreme conditions.

In the early 21st century, our High-Pressure Laboratory at Stony Brook began a research program with Michael Carpenter from Cambridge. We studied elastic anomalies accompanying phase transitions in (Ca, Sr)TiO_3-perovskites with Baosheng Li [14] and the structural evolution, strain and elasticity of perovskites at high pressures and temperatures with Carpenter's colleague Peter Sondergeld [15]. Somewhat later, Carpenter's team studied elastic and anelastic relaxation in hematite [16], which was the same mineral on which I conducted my first ultrasonic experiment [17].

Most, if not all, of my Cambridge connections have visited our High-Pressure Laboratory at Stony Brook, including Ross Angel, Michael Carpenter, Desmond McConnell, David Price, Andrew Putnis, Simon Redfern, Ekhard Salje and Peter Sondergeld.

4.2. University College London (UCL)

I have had extensive interactions with colleagues in the Department of Earth Sciences at University College London, including David Price, John Brodholt, David Dobson, Phil Meredith and Lidunka Vočadlo, with whom I had many discussions about mineral physics when I visited two decades ago

> David Price obtained all of his degrees at Cambridge. In 1993, Price and Renata Wentzcovitch were the first to use quantum mechanical molecular dynamics (QMD) methods to study mantle-forming phases, and this led to the first applications of this method to the study of the high P/T elastic and seismic properties of silicates, and which more recently enable his group to reconcile the previously seismically enigmatic D" layer at the base of the mantle (depth ~2600 km to 2880 km) with the properties of the recently discovered post-perovskite phase.

John Brodholt has focused his research on the mineral physics of the Earth's core and deep Earth.

With colleagues at UCL and the Bayerisches Geoinstitut, David Dobson has

performed high-pressure experiments on deep Earth minerals and rocks using several high-pressure devices, including multi-anvil presses, diamond anvil cells and a modified Paris-Edinburgh cell for neutron diffraction. With Lidunka Vočadlo, he has been investigating the iron-alloys which are stable at high pressures. They have discovered a new high-pressure phase of FeSi which is a prime core candidate material.

The late Paul McMillan joined the UCL faculty in 2000 after many years at the Arizona State University. His primary interest was in the study of matter under extremes of temperature and pressure for which purpose he used both diamond anvil cells and multi-anvil presses. His work was extraordinarily broad taking in fundamentals of geochemistry, the study of pressure-induced amorphisation and the quest for liquid-liquid phase transitions, Raman and optical studies of materials under high pressure and, in recent years, electrochemistry, energy conversion materials, the study of proteins, bacteria and small invertebrates at high pressure.

Lidunka Vočadlo's research is directed toward Ab initio simulation of the thermoelastic, melting and dynamic properties of planetary forming materials; cryogenic-high T /high P experiments on planetary-forming materials; and ab initio simulation of the high P/T properties of metals.

4.3. University of Oxford

At the University of Oxford, my connections have primarily been with Shamita Das, Bernie Wood and John Woodhouse and Andrew Jephcoat.

Shamita Das' research is on earthquake source mechanics; she has developed a numerical model of earthquakes that enabled prediction of aftershocks. I first met Shamita when she was at the Lamont Doherty Earth Observatory working on the relevance of the source point of an earthquake with respect to its size.

Bernie Wood is well known for his work on the behavior of trace elements [1]. He has developed models to study compatibility and predict trace element partitioning between crystals and melts, which are relevant for igneous differentiation. I met Bernie when he was on the faculty of Northwestern University from 1985-1988.

John Woodhouse is widely recognized for his pioneering and unselfish contributions to theoretical, observational and computational seismology, which led to major discoveries on the Earth's internal structure and earthquake characteristics.

Also, Andrew Jephcoat, whom I first met at the Geophysical Laboratory in Washington in the 1980s and later at Okayama University in Misasa, Japan.

5. My English Heritage

I am indebted to my aunt, Jane Cooper Sutton, for much of this history. My mother, Catherine Alice Cooper Liebermann was born in Slippery Rock, Pennsylvania in 1916. She is pictured below on the porch of the family home in her rocker and favorite doll.

She is a descendent of Edward Doty from Lincolnshire, England. Doty was a passenger on the ship Mayflower which sailed from Plymouth, England in September 1620 and landed on Cape Cod two months later. The Mayflower passengers established the first permanent settlement of Europeans in North America.

My mother is related to Edward Doty via his great-granddaughter, Mary Doty Coleman who married Pvt. Moses Cooper in 1751. Moses was born Southampton, New York on Long Island; I have discovered a Cooper headstone in the cemetery there. In 1776, Moses moved his family to western Pennsylvania to avoid conflict with the British army which controlled Long Island at the time of the American Revolution. His large family traveled by horseback and crossed the Allegheny Mountains; unfortunately, Moses failed to reach the journey's end and died on the way.

My mother is the great-great-great granddaughter of Moses. She was elected to the Mayflower Society in 1972 (see certificate below).

On the Cooper side before Moses, my mother's ancestors originated in Olney in Buckinghamshire, England. In 1635, John Cooper sailed on the ship Hopewell and settled in Lynn, Massachusetts for 4 years, before departing for Southampton, Long Island, New York, becoming one of the first families to form a settlement there.

6. Conclusion

This paper summarizes my research connections with English scientists over the past six decades. I have presented both the scientific achievements and the personal connections which resulted from these collaborations. Finally, I document my own English heritage and my Cooper ancestry leading back to Edward Doty, a passenger on the ship Mayflower in 1620.

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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