Reply

PAGE 148

Glenn Brown takes issue with my statement, "It is hoped that Maxwell's contribution to the foundations of fluids in porous media will receive due attention, and that his novel approach will lead to new insights." He considers that, because Maxwell did not explicitly develop his theory for fluid flow in porous media, his ideas should not be treated as a contribution in that area. Brown contends that doing so is a disservice to Darcy, and is revisionist.

Brown and I differ in the way we perceive science. He looks at the material I have presented from an ideological perspective of upholding Darcy's position in history. On the other hand, I do not question Darcy's valid contribution. Rather, I presented some of Maxwell's fascinating ideas that are relevant to the study of fluid flow in porous media, published in the same year Darcy published his seminal work. I have shown that the relevance of Maxwell's ideas to flow in porous media has gone unnoticed in the literature. Scientists are fallible human beings, and important ideas and thoughts are occasionally overlooked. When, on a rare occasion, we chance upon such an oversight, it is part of our scientific enterprise to bring the finding to the attention of the scientific community. It is up to the community to judge the historical significance of the new information.

As I took care to point out, Maxwell's "imponderable incompressible fluid" is an artifact and a metaphor. At the same time, it is remarkable that Maxwell's fictitious fluid has all the essential attributes inherent in Hubbert's theory that placed Darcy's Law on dynamical foundations. The relevant attributes include impelling and resistive forces, refraction of flow lines at interfaces between media of contrasting resistance.

One of the subsections of *Maxwell* [1856] is titled, "II. Theory of the uniform motion of an imponderable incompressible fluid in a resistive medium." Since we all accept that "resistive" and "permeable" are closely related ideas, perhaps the relevance of Maxwell's work to flow on porous media may be more apparent if one were to substitute "permeable medium" for "resistive medium" in the subsection title. It is not uncommon nowadays to refer to porous media as permeable media.

Brown asserts, "Maxwell's later and definitive publication on electromagnetism did not use the fluid analogy." This assertion is rendered invalid by the following excerpts from *Maxwell* [1881]:

"There is nothing therefore among electric phenomena which corresponds to the capacity of a body for heat. This follows at once from the doctrine which is asserted in this treatise, that electricity obeys the same condition of continuity as an incompressible fluid...." (p. 336)

"The difference between the two phenomena may be compared with the difference between forcing a current of water through a long capillary tube, and forcing water through a tube of moderate length up into a cistern" (p. 357, in discussing electrolytic polarization).

Although *Maxwell* [1856] took pains to emphasize that the incompressible fluid was fictitious, he seems to have become more articulate in later years in comparing electric current to an incompressible fluid. As I speculated in my article, young Maxwell probably wanted to avoid getting into the aether controversy and simply focus attention on comprehending the phenomenon of electricity. In taking this path, he was in good company. At the turn of the 19th century, some scientists believed that heat was a fluid (caloric), while others such as M. Lavoisier, P. S. Laplace, and J. B. J. Fourier were inclined toward considering heat as a manifestation of kinetic energy. Nevertheless, *Lavoisier and Laplace* [1783], in presenting their work on the first ever calorimeter, took care to state that their results were valid regardless of what the nature of heat was. *Fourier* [1822] also expressed himself similarly.

In conclusion, my view is this: regardless of whether Maxwell advanced a theory explicitly crafted for the study of flow in porous media, it is in the spirit of science to take proper note of Maxwell's contribution should it in fact prove to be of relevance to and have the potential for providing insights into the understanding of fluids in permeable media.

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—T. N. Narasimhan, University of California, Berkeley

SECTION NEWS

VOLCANOLOGY GEOCHEMISTRY & PETROLOGY

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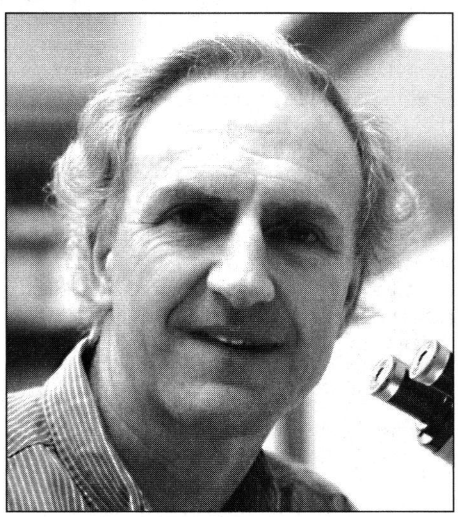
PAGES 149–150

Valley Receives 2003 N.L. Bowen Award

John W. Valley received the Bowen Award, presented by the Volcanology, Geochemistry, and Petrology Section at the 2003 Fall Meeting in San Francisco, California, last December.



Citation

"Jim O'Neil and I are particularly pleased to present Professor John Valley, of the University of Wisconsin, for this year's Bowen Award. We have known John for about 25 years, first as a graduate student, and now as colleague and good friend. We nominated him in recognition of his recent work on zircons from early Archean rocks of northwestern Australia, which provides documentation of previously missing Earth history with evidence for an early ocean and a relatively cool history during the Hadean Eon. John has also published a major review on oxygen isotope variations of magmatic zircons preserved through geologic time, as a result of which he proclaims that 'zircons are forever.'

"John's research interests are exceedingly broad, although most involve stable isotope measurements of materials involved in diverse Earth and planetary processes. In the last 5 years, he has authored or co-authored papers on a wide variety of topics, such as the early Archean history of the Earth, Martian meteorites and their association with possible life forms, sedimentary basin flow regimes, geochemistry of ocean island and continental volcanic rocks, mammalian paleodiets, characterization of biogenic magnetite, and authigenic and diagenetic minerals, and has conducted ongoing projects focused on his longstanding interests related to fluid flow. John published a major review paper on the use of the ion microprobe to obtain stable isotope ratios of natural materials, and he edited and contributed to several books on stable isotope geochemistry that are widely cited and consulted. His work continues to draw a great deal of attention both here and abroad. His productivity has continued unabated despite his many administrative obligations in professional service to the University of Wisconsin, as well as to many national and international organizations.

"Professors Don DePaolo of the University of California, Berkeley, Colin Graham from the University of Edinburgh, and Ed Stolper of CalTech provided glowing letters of recommendation on John's behalf. It is evident from these recommendations and John's vita that he is a highly active and cooperative scientist in geochemistry, petrology, and related fields. He maintains ongoing collaborations in a wide variety of fields with scientists from many institutions, both in this country and abroad. John has proven to be one of the most successful of the many academic scientists who obtained their Ph.D. degrees from our department.

"John has been a highly influential colleague both in the United States and internationally. He has initiated and maintained valuable connections with professors at the University of Edinburgh and at CalTech, and these collaborations have led to major research initiatives, some of which are ongoing. He has developed a large and lively research program with many postdoctoral fellows and visiting professors as well as a continuing cadre of enthusiastic graduate students. Most of his former Ph.D. students and postdoctoral fellows are now tenured professors, which only adds to his stature. Considering the outstanding quality of the nominee's research, the quality of the papers for which he is cited, and his productivity, he meets the criteria of the recipient of this award exceedingly well. With the highest praise, we present to you the Bowen Award winner of 2003, John W. Valley."

—ERIC J. ESSENE, and JAMES R. O'NEIL, University of Michigan, Ann Arbor

Response

"It is a great honor to receive the N.L. Bowen Award from AGU. It's a pleasure for it to be presented by Eric Essene and Jim O'Neil, who have been good friends for 25 years and have both greatly influenced my career. The Bowen Award is very special because of the distinguished past recipients and because of its namesake.

"It's appropriate to say something about Bowen on this occasion. As a dedicated magmatist, he only forayed into metamorphism a couple of times, but it was typically brilliant. I especially enjoy his terse summary of metamorphism in marble, 'Tremble, for dire peril walks. Monstrous acrimony's spurning mercy's laws.' We all know at least the first five index minerals (tremolite, forsterite, diopside, wollastonite, periclase), but fewer of us realize that, written in 1938, this phrase was also a political warning against appeasing Hitler. I think this illustrates that even the specialist Bowen was aware of what we might now call 'broader impacts.' We should not lose track of what's going on around us.

"I want to mention some of the people who have helped me to be here tonight. There are many more. My parents first exposed me to geology and the outdoors. At age 6, they gave me a shiny new rock hammer. This was quite a lethal instrument for one so young. They instructed me, 'don't stick the pointy part into your forehead,' and we visited gem pegmatites in Maine and hiked the White Mountains of New Hampshire. This influenced me to go to Dartmouth, where I was fortunate to study with Dick Stoiber and to spend a month with him in Guatemala.

"I went to Michigan for graduate school still thinking about andesite volcanoes. But Eric Essene convinced me that rocks are more interesting if they don't melt. Eric had a great group of students. He gave us equal doses of hard work and fun, of metamorphic petrology, mineralogy, and critical thought. My M.S. was petrologic. I looked for regional patterns in fluid compositions from Adirondack marbles. Of course, we know now, there aren't any regional patterns. Fluids, when they exist in granulites, are localized. Again, I was influenced by Bowen who said, 'to many petrologists, a volatile component is exactly like a Maxwell demon; it does just what one may wish it to do.' I took his sarcasm as a challenge to set quantitative limits on the role of metamorphic fluids and how they interact with rocks.

"John Bowman showed me that stable isotopes are a powerful tool for studying fluids, and he introduced me to Jim O'Neil, who was then at the U.S. Geological Survey in Menlo Park. With Eric's blessing, I redirected my Ph.D. to include stable isotopes. There was no isotope geochemistry at Michigan in those days, so this entailed many enjoyable trips across the country.

"My experiences with Jim are what finally shaped me as a geochemist. He generously shared his knowledge and his lab. The isotope world was smaller then. Jim felt the pulse of the science. He knew everyone, what they did, and what were important problems. Jim also had great equipment. At night, I could run the silicate extraction line and two mass spectrometers simultaneously. This is something I tell my students never to do.

"My first job was at Rice. In 1982, Dieter Heymann, Rob Dunbar, and I wrote a proposal to buy an ion probe. I was tired of hand picking minerals. It's probably a good thing we weren't funded because we had no idea what we were getting into. No one did. The multi-collector instrument we actually needed wasn't built until 15 years later. Rice was good to me, but Andrée and I jumped for the chance to live in glaciated Wisconsin on the edge of the shield.

"We moved to Madison with four Rice students. These and others have been the most satisfying part of my career. Will Lamb demonstrated fluid absence in granulite facies metamorphism in the Adirondacks; Jean Morrison proved that the Marcy anorthosite massif intruded as a high $\delta^{18}O$ magma; and Claudia Mora worked out the complexity of metamorphic brines at Boehl's Butte. Later, Steve Dunn demonstrated polymetamorphism at the Tudor gabbro, and Doug Crowe made the first laser probe analyses of sulfur isotope ratio. Jim O'Neil suggested using a laser for oxygen isotope analyses of silicate minerals in 1985. A lot of people have made good use of our laser system since then, including Matt Kohn, Ilya Bindeman, Liz King, and Jade Star Lackey.

"In 1989, I went to Edinburgh on a Fulbright to try out their new Cameca 4f ion microprobe. This technique offered the promise of in situ analysis for sample sizes one million times smaller than by laser, but no one knew if it would ever be accurate enough for terrestrial studies. I set a goal of 1 per mil for precision. Colin Graham, John Craven, and I worked the whole year on oxygen isotopes. We had a spectacular, unbroken record of failures. It was like lightning. We never got the same number twice, even on standards. I won't bore you with the reasons, but I learned that ion probes are hard! Finally, in my last week we broke the 1 per mil barrier; we drank champagne and planned for the future.

"John Eiler and I have been back to Edinburgh many times, and our collaborations with Colin and John have included the most fun science of my life. Later, William Peck accompanied me to Edinburgh with Jack Hills zircons, including the one that Simon Wilde dated for us at 4.4 Ga. This was part of a larger study. We were analyzing zircons of all ages to investigate maturation of the crust. I had assured William with all my full professorial authority that any zircon from an igneous rock from so early in the Earth's history would be primitive in oxygen isotope ratio. Of course, that's not what we found, and the simplest interpretations led to quite an interesting hypothesis as Eric has mentioned. Now we are buying an ion probe in Madison and we are going to test our model.

"I want to close by thanking my wife, Andrée, who is here tonight. She helped on many projects. Throughout, she has given me the encouragement and freedom to work on rocks, whenever I wanted. That's been very important.

"Thank you all. It's been great fun, and it keeps getting better."

—JOHN W. VALLEY, University of Wisconsin, Madison