a.p. black
research award

Michael R. Schock

Honored With 2011 A.P. Black Research Award

MICHAEL R. SCHOCK IS THE 2011 RECIPIENT OF THE A.P. BLACK RESERCH AWARD. ESTABLISHED IN 1967 IN HONOR OF ALVIN PERCY BLACK, THE AWARD IS GIVEN ON AN AS-DESERVED BASIS TO RECOGNIZE OUTSANDING RESEARCH CONTRIBUTIONS TO WATER SCIENCE AND WATER SUPPLY RENDERED OVER AN APPRECIABLE PERIOD OF TIME.

Your résumé shows that your Bachelor's and Master's degrees were in geology, which made me wonder how you ended up studying drinking water distribution system chemistry.

I had a lot of interests growing up, especially in the physical sciences. My first intent—after I had to give up my dream of being the pilot of a "hurricane hunter" when my eyesight went bad in fourth grade—was to go into astronomy or space exploration. But the early 1970s saw a winding down of the space program, astronomy was moving more toward theoretical cosmology and radio astronomy than the observational stuff that appealed to me, and I wasn't especially good at advanced math. I also found geology and geochemistry very interesting and related to the development and evolution of planets, so I set out in that alternative direction. I took advanced geology and chemistry and became fascinated by being able to analyze elemental and mineralogic compositions by various spectroscopic techniques and by being able to age-date the formation of rocks and predict the interactions of rocks and minerals with surface waters and groundwaters—and that opened the door to environmental issues tied to the geosciences.

I think my career has benefitted a lot from fortuitous accidents and involvement with individuals who took the time to nurture some skills in me. I've learned a tremendous amount from collaborating with consultants and utilities, which has given me insights into the practicality of treatment solutions, but also an appreciation of the time frame, public eye, and regulatory framework of the real world. It has also given me some of my most important research ideas. Working with these individuals and my work colleagues inspired me, influenced both the shape and scope of my career, and encouraged me to try to pass it on in a similar way to other new colleagues I've worked with along the way.

It appears that you made the decision to focus on drinking water fairly early on, considering that you began working at the US Environmental Protection Agency in 1978—which was also the year you became a member of AWWA—and two years later began publishing peer-reviewed research on corrosion control and lead solubility. What guided your career in that direction?

I was in a PhD program at the time, but funding wasn't really following the areas I was particularly interested in studying with the level of dedication a PhD student needs, and I had been keeping an eye out for jobs in environmental or space applications. The agency was looking for a laboratory analysis and pilot-plant technician. That caught my interest, and when I interviewed I found that it was to support some new research aimed at solving a large drinking water lead corrosion problem in the northeastern United States. There were some recent papers suggesting that perhaps pH adjustment or the addition of some carbonate chemicals might help, but the overall picture was fairly muddled. I found the seriousness of the issue quite compelling, and it was a great hands-on fit to my laboratory analytical interests as well. Corrosion control, after all, is really aqueous geochemistry with relatively very short time frames and some extra non-natural oxidants. So, I left school to take the job. The agency's drinking water research program at that time was full of folks who we all now regard as true legends and "founding fathers" of modern drinking water treatment research, many of whom already were or later became recipients of the A.P. Black Research Award. I don't know the exact percentage, but a large fraction of the drinking

water staff were actually part of the US Public Health Service, and their enthusiasm and dedication to researching and solving health-related water quality problems was highly contagious. It was a different blend of approaches and interests from my prior experience in the academic world, but it filled an important niche in getting the science applied at the community level. I also found the interrelationship between the need for good background science and implementation engineering to be the kind of "team" work environment that fits well with my natural personality and skill sets.

Your interest in these areas spans more than 30 years—and several of the letters of nomination for this award noted your passion and drive to understand the chemical basis of water quality. What is it about these areas that inspires you?

I admit I have always liked the idea of making a scientific splash (no pun intended . . .) and leaving, I hope, a good scientific legacy. I think one of my stronger skills is being able to "connect the dots" and integrate knowledge from different disciplines. That's definitely something that grows from a geosciences background, which is based on applying numerous fundamental sciences to a "natural" situation. I think Mother Nature has some distinct, consistent laws of chemical behavior and order to natural systems, so it's an interesting puzzle to find the pieces that go together to solve existing problems and prevent future ones.

Colleagues have termed your findings in the field of distribution system research as "landmark work" and credit you with laying the foundation for the work they're doing today—many of them becoming involved, they say, because you took the time to discuss its importance with them and encourage their efforts in this direction. Did you make a conscious decision to mentor young professionals entering the field or do you think it came about as a natural outgrowth of your passion for this field of study?

I wish I could say that it's my purely altruistic streak that motivated this, but it's a lot more complicated than that. Science is far bigger than one person, and even geniuses usually specialize and only see a small part of whatever problem they're working on. I often draw on the analogy of the old parable about the blind men describing the elephant, which I think is remarkably pertinent to the drinking water treatment challenges we face. The more everybody knows, the more talent, insight, and information we can bring to bear to solve the problem. It truly takes a team to look at all of the aspects of water quality and health protection research and applications. It takes time, effort, and extreme focus to try to learn what's needed. I'm totally grateful for the help, coaching, mentoring, and inspiration of many colleagues as I got started in my career and progressed. I like trying to teach and help others when I know something of value to them, because in the end, they will be more effective contributors to the team effort. After that, they'll have more knowledge and confidence to then go forward on their own and build on it, and perhaps be inspired to contribute back.

The importance of research findings may not always be clear at the time a study is published. In fact, several individuals noted that your work on lead(IV) appeared to be mostly an "academic exercise" when first published, but later burst to prominence as the explanation for the high lead content in the water in Washington, D.C., from 2001 to 2005. What was it like to have your life's work suddenly become must-have information?

It's been gratifying to see that the Water Research Foundation and other organizations have taken some of the research to heart and funded additional research beyond what we could do, but, ironically, it's never really translated into growth of the research program. Maybe it's also because we're often finding problems that are "inconvenient truths" and are most difficult to solve, so we have made treatment and regulatory life much more complicated. It is very personally and professionally gratifying to be right, even when you sometimes feel like a lonely wolf howling at the moon. My colleagues and I have always taken great pains to cross-check what we're finding when it's very unusual, precisely because we know that a lot is at stake and that we are in an important position of visibility and influence. I think the biggest reward is knowing we have provided insight that enables a health problem to be solved and future problems to be anticipated and prevented.

When you were working on these studies, did you have any idea that the findings you were accumulating would take on such significance in the industry?

Interestingly, few of what have turned out to be "breakthrough" studies from my career were really well-supported or well-resourced from the start. So much of the research conducted in this field is based on chasing the hot topics and where the money and resources flow, and I've rarely benefitted from that. I had the luxury, if you could call it that, of having been in a position where I had the flexibility to investigate scientific issues with at least a basic level of support through instrumentation and lab facilities, sometimes money for in-house students or contractors, and, of course, the support of my immediate management that what was being investigated was important enough for the time and money expended on it.

Much of the exciting work that leads to a new and better understanding of treatment interrelationships and corrosion effects stems from a commitment the agency's had for a long time in directly helping utilities, consultants, and states solve water quality or regulatory compliance problems. So, it's usually been a case of research on one topic or trying to figure out what's going on in city X's distribution system leading to some new data or new finding that suggests additional issues. Ironically, we have so much research that extends these findings and makes forays into some new ap-

plications of concepts, that we often get scooped by others before we can get them written and published.

What do you consider to be your most important contribution to the field of water science?

That's kind of like asking a parent to pick their favorite child. I like different things about the different major research areas I've worked in. I think maybe the legacy I'd most like to leave is the synthesis of equilibrium or quasi-equilibrium principles with rigorous analytical measurements. It's not an insult to have your theories improved upon; it's the natural course of things. You have an inherent obligation to the science to make sure the analytical or experimental work is top-notch and transparent, so it can be a stepping stone for others. I think there is a lot more trial-and-error and rather scattered *un*-rigorous thinking that often goes on in this field, and I hope that maybe some of these successes will inspire others to bring an interdisciplinary and systematic approach to corrosion and treatment chemistry.

What was your most challenging assignment?

I think the biggest challenge to me isn't a specific project, because most of the research has just evolved as we seek answers to the next set of problems or conflicts that we're trying to help someone in the drinking water community to solve. To me, the biggest challenge is just to keep the research going in times of decreased funding and resources. This kind of applied research isn't sexy or amenable to catchy slogans, so it often falls through the cracks or doesn't compare well to glamorous proposals that seek to make it appear that their work will lead to some kind of total change in civilization. This work is incremental, like the way water systems have to solve their successive rounds of regulatory and resource/economic challenges. They can't be torn down and replaced as units and be fully functional overnight with no disruption in service. Not to mention at almost no cost . . . .

There were several common threads that ran through the letters of nomination AWWA received on your behalf, one of which spoke to your conviction that water professionals and regulators are "servants of the public trust" and that together we must develop a new, novel approach to creating practical, honest, and implementable regulations. Have you thought about what such an approach would look like? Or what elements it might contain?

That characterization probably came about because of the strong formative influences my early Public Health Service mentors had on me—to see our role as being advocates for the health of the consumers and to be providers of unbiased scientific information that water systems can use to treat the water, control corrosion, and ensure proper disinfection and that private industry can use to develop new technologies. We should have a no-profit agenda and be servants of the people as part of the executive arm of the government. One of the limitations we often run into is that statutory authority to control problems before they start just does not exist. Similarly, there are all sorts of institutional and statutory barriers to even simply monitoring at consumers' taps, which is exactly what we really care about—the quality of the water that the consumer receives. So a fully integrated approach is needed that cuts across agencies when necessary, is technologically and economically feasible, is implementable by staffing that states actually have, includes industry code and practice organizations, and is scientifically brave to adapt to new research information.

Your keynote address at AWWA's Annual Conference this past June included comments about the gap between "theory" and "practice." What techniques, approaches, or venues do you see that could build a bridge between these? [Editor's note: To view Schock's full address, go to awwa.org/video.cfm?ItemNumber=57351.]

I don't have a good answer for how to fix it, but I consistently find that there is a huge gap between the current "state of the art" for water treatment and the understanding of corrosion control approaches and what seems to be getting told to operators in small community and noncommunity water systems. (This issue also applies to smaller consulting firms and many state regulatory staff.)There also is a gap between some of the plumbing codes and practices and compatibility of the pipe and device for the waters in which they're installed. For instance, people continue to install cement linings in water qualities they shouldn't and copper or plastic pipe in water qualities or operational scenarios that they shouldn't. Galvanized pipe was probably prematurely driven from the market because of misapplication. It would be great in many of the waters where we now see copper and lead problems!

It often seems that no matter how much is written on some topics, it never penetrates down below the very large municipal water system and high-powered national consulting firm levels. Maybe we need to take a much harder look at the educational materials that the typical water industry professional actually sees and uses during his or her career and make sure there's a better synthesis of knowledge in there.

You also noted in your address that "one man's corrosion product is another man's removal media." For those who don't have a chemical background, could you explain what you meant by that?

It was partly facetious, but it's really true. Our research on metals accumulation in water distribution and premise plumbing systems clearly shows that even at trace levels the simple ferric oxyhydroxide corrosion by-products of

iron pipe corrosion and the widespread deposition of manganese compounds throughout piping systems are excellent sinks for metals entering these systems. It should have been obvious sooner that this was a basic, widespread phenomenon. Industrially manufactured synthetic versions of these "natural" drinking water deposits have been being engineered for years for the express purpose of removing metals from contaminated water bodies.

Your "fire" about water quality came through in your address as you began to speak about unresolved issues or misconceptions. Why do you think misconceptions persist for so long? What do you think can be done to change that?

This is a mystery that probably ranks right with what happened to Atlantis and those planes lost in the Bermuda Triangle. I alluded to it in an answer to another question—we need to understand and realistically address where the majority of water system operators, their certifiers, the regulators, and smaller consulting firms get their information. Maybe it goes to undergraduate textbooks and meager corrosion chapters? I definitely think we need more personal and ongoing professional training at all levels. The web is good for some things, but there's no substitute for direct interactions in a low-pressure, informal, environment.

Coming from an outside discipline, so to speak, I have less insight into the origin of some of the errors or misconceptions than traditional environmental, civil, and sanitary engineers probably have. I do know, though, that colleagues in other specializations have had similar moments of banging their heads on their desks after hearing of an action or decision that perpetuates a misconception.

In your keynote, you also said that we need to put control of the materials that are in contact with water in the hands of water suppliers and the industry as a whole. Can you expand on what you believe we could achieve by doing this?

I think it's a pretty simple concept—so obvious, it's overlooked. There's a complicated interconnected web of chemical treatment conflicts as utilities try to simultaneously address many treatment objectives and regulations. The need for corrosion control chemicals exerts a nonrenewable resource demand, and at some point, the addition of phosphate becomes costly and adds incrementally to the background load that must be removed by many wastewater treatment plants. The less water quality needs to be manipulated for corrosion control, the more money and resources can be saved. It also helps avoid some disinfection and disinfection by-product formation conflicts.

With highly efficient water conservation design in high-rise multifamily buildings, the stagnation times of the water increase to where it challenges or goes beyond the historical expectations of the materials, and possibly even the capability of the best finished water corrosion control and disinfection treatments. The water industry, usually in the form of some water quality regulation—but possibly just in the perception of consumers—ends up with responsibility for the real or perceived water quality. If, for instance, water is discolored or has a high level of some contaminant, the utility gets the call and blame, not the plumbing inspector or code body that found the offending material acceptable. There needs to be a confluence of engineering objectives and water quality objectives. Overall, public health would be better protected, and treatment complexity and costs would be lower if the materials installed were ensured to be compatible with the water quality and treatment schemes practiced in that locality.

You conveyed a sense of urgency that there needs to be a merging of water, energy, green building, and conservation practices. Would such a "merger" go beyond what we know today as integrated resource management?

I have just begun to learn some of the aspects of this area, so I have a current focus primarily on the issue of maintaining healthy water quality past the distribution system mains. I am seeing more conversation across disciplines and areas of interest, which is promising. I don't know to what extent premise plumbing water quality issues are being incorporated into integrated resource management, but I suspect that there still is a gap because of the different boundaries of legal responsibilities that we currently have.

It seems that a large part of what stirs your passion is your desire to protect public health. Do you think that there is less emphasis on this today than there was when you entered this profession?

My observation, over the course of my career, is that there appears to me to be less passion and focus on public health, and more focus on the economics of operation and the process of regulation. It is, of course, an opinion based on my vantage point, and it may be very different in other organizations or communities.

What advice would you give to those who are just beginning their careers in the water industry?

I think there are broad opportunities in different sectors of the water industry that may take time to become aware of. There are good fits to many educational histories, research interests, and work habits—in both the public and private sectors—and certainly, there are a lot of emotional rewards and satisfaction that can be had for a job well done. It is truly a field that benefits greatly from bringing a team of perspectives and expertise to bear. I would advise a lot of scientists to think a bit outside the box and give strong consideration as to how their expertise—be it analytical, biological, metallurgical, physical, geochemical, or otherwise—could help water systems, regulators, and consultants with maintaining such an essential support to civilization as we know it and with supporting what is truly an important environmental cause for those called to it. There are infinite opportunities to make a positive mark with your career.

On the Personal Side

Just as my route to a career in this field has been rather unusual, I have always had a very diverse set of hobbies and interests. I've maintained most of them since growing up, although I didn't discover golf until my mid-thirties—which I also find is a really great way to do butterfly, wildflower, and bird-watching, if I play the right courses. I grew up in a suburb of an Air Force town—Dayton, Ohio—so I had a lot of exposure to military aviation from childhood. It's also an area rich with early American history and Native American life. So, I've been an avid reader of all sorts of history and historical fiction, and I've had a great interest in aviation history, particularly from World War II onward. I still have 100+ scale model historically accurate aircraft models that I built in my twenties and thirties. On my current bucket list is taking the opportunity whenever possible to fly in World War II vintage aircraft [see the photograph at left]. I have also maintained my interest in astronomy. I spent countless nights out with my telescope growing up, sometimes at the expense of school work. I look forward to reviving that as a retirement hobby. I signed up for the Advanced Observation Program for Amateurs at Kitt Peak Observatory [56 miles southwest of Tucson, Ariz.] last year and used its program telescope to image two of my favorite astronomical objects, the M-51 Whirlpool galaxy [shown on the cover] and the M-3 globular star cluster. Flynn Haase of the observation program staff was my mentor for the night, and I give him full credit for the software manipulations and setup. The photo of the galaxy is an overlay of many images taken

Schock's interests are many, as shown in this photo collection: (from the top) flying in World War II aircraft such as the Liberty Belle B-17, watching the final Atlantis shuttle launch, traveling to geologically (and historically) interesting places such as the Hawai'i Volcanoes National Park, playing team sports (as with the Blue Ash YMCA over-30 team), and playing guitar with friend Tim Kehoe this year at a charity benefit on St. Patrick's Day.

over several hours using a CCD [charge-coupled device] camera in red, green, and blue light, integrated with a luminosity (white light) image.

Also in line with my space and aviation interests, my wife and I got tickets to view the last two Space Shuttle launches from the Kennedy Space Center Causeway [Fla.]—a sad but amazing experience. The photo is from the last flight of Atlantis lifting off (see the photograph on the facing page). I'd go up in a shuttle in a minute, if I had the chance.

I'm a geology and earth science buff, and I and my wife Sue (who is also a geologist by training) like to travel to geologically and historically interesting places for vacations. One of the two photos taken in Hawai'i show me taking pictures and walking through a calderea in Hawai'i Volcanoes National Park (a truly awesome experience). The other is of my wife and I on the island of Oahu, where we were visiting Chitteranjan Ray, our friend and colleague from Illinois State Water Survey days, who took the photo.

I like gardening with perennials and native trees, and I enjoy nature photography—another probable retirement hobby.

Like most things about me being a rather eclectic mix, if I had to pick my favorite movies, they would probably be: *Star Wars* (the original), *The Magnificent 7, The Longest Day, Forbidden Planet,* and *Out of Africa.* Maybe *Monty Python and the Holy Grail* and the *Lord of the Rings* trilogy fit in there, too! My favorite TV show is "In Plain Sight" (maybe another JOURNAL reader out there has actually seen it—but maybe not).

I love team sports, generally, and though I don't play baseball and softball any more, I do still play basketball as often as I can, and I run (for exercise) and play golf. An amusing photo [see facing page] is of a team I was on in 2000 in the Blue Ash [Ohio] YMCA over-30 league, where we not only went an undefeated 8–0 that season, but were also the only team in the history of that league to ever score 100 points with a 40-minute running clock! (The guys in the back are making hand signs 1-0-0).

Music has been a big part of my life for a long time, so I worked some extra consulting jobs and got a state-of-the-art audiophile quality stereo system in the late 1980s, which is still pretty special. In addition to listening to all sorts of music, ranging from New Age to classical to folk to rock, I've also played guitar since college. My main interest has been folk and folk-rock music from the 1960s onward, but in recent years I've apparently been influenced by my mostly-Welsh heritage and started taking lessons in Celtic music.

Mike and his wife Sue pose on the island of Oahu during one of their trips to Hawai'i. The photo was taken by their friend and former colleague from the Illinois State Water Survey, Chittaranjan Ray.

My parents somehow instilled a drive in me to excel at something of my own, something I could be proud of. They pushed me to be good at something, and they gave me a lot of latitude to find my own direction. I was interested in so many things it was hard to stay motivated with just school work, so I wasn't the best of students overall. But the idea of wanting to be good at something and to be able to be proud of some accomplishments and leave a positive legacy from a career took root.