

Priestley and me

by John D. Roberts



Jack Roberts receives the Priestley Medal from Mary L. Good, president of the American Chemical Society.

I AM VERY PLEASED and greatly honored to receive the Priestley Medal. Let me start off by saying that I am very deeply appreciative of the marvelous students and postdoctoral fellows whose achievements I have cheerfully taken credit for over the years, as well as the representations (and I hope not misrepresentations) that I assume to have been sent in on my behalf, by colleagues and friends, to make possible my being with you tonight. I am reminded of a cartoon I saw in the paper the other day, wherein an Oscar recipient, clutching his statuette, is standing in front of a microphone, saying, "That covers the thank-yous to the people of the first year of my life. Now, for the second year . . ."

For those of you who may be in this spot next year, or in future years, let me warn you that getting the Priestley Medal is definitely not like getting an Oscar from the Motion Picture Academy. There is no last-minute surprise; indeed, it is more like the water cure. The chairman of the American Chemical Society board will call you up in April and ask if you will accept the medal, and then, if you say yes, you will have about 360 days to worry (and I'm inclined to worry) about what you are going to say when the big day arrives. And, in the meantime, you will get a three-inch stack of letters (and very nice letters indeed) congratulating you for having already received the Priestley Medal, long before the fact. All of this at a time when you have no certainty as to whether you will even be alive for 360 more days. I decided I would answer those congratulatory letters after I had the medal in my hand.

Of course, the ACS board does not tell you why you were chosen over other worthy candidates. When I was much younger, I had the perception that the Priestley Medal was awarded almost exclusively to those much-admired and selfless individuals, such as

Roger Adams, Charles A. Thomas, and W. Albert Noyes, Jr., who were not only great chemists in their own right, but also served with distinction as the ACS president, ACS board chairman or the like. However, a review of the list of past awardees indicated that such service is not necessarily the most important factor. So, as an experimentalist, I thought it might be interesting to see if I could find a more common trend, and I did.

Taking the last 20 awardees as a representative sample, the common factor is not field chemistry and not ACS service. It turns out to be maturity. You have to ripen to get into the club. Whatever the other requirements, you just plain have to live long enough. This became clear when I plotted the age of the Priestley recipients against the year that they got the medal. There is a very distinct upward trend. Naturally, there is some scatter in the plot, but, with a correlation coefficient of 0.66, the intercept of the least-squares line is 60 years, and the slope is unity. For the less mathematical of you, this means that the most probable age for the Priestley Medalist in 1966 was 60, and that age has increased by 10 years every 10 years — so that in 1996, the most probable age will be 90 and by 2006, it will be 100! I feel especially honored to be chosen about ten years ahead of the current expected norm.

Having demonstrated the will to achieve the maturity required for the Priestley award, let me say why it is so wonderful to become associated with the name of Joseph Priestley. The fact is, if you do a little research on Priestley, you start to wonder how it was, in the early 1920s, that the somewhat conservative American Chemical Society was willing to take him as the symbol of their highest award. No doubt that Priestley was a remarkable man. He achieved scientific immortality for the discovery of oxygen —

an element essential to life and an element of great interest and importance to chemists. But Priestley was not a chemist — his contemporaries thought of him much differently. He was a minister; he held several academic positions for teaching languages, of which he knew at least eight; he was a vigorous spokesman for educational reform; to be sure, he was a natural philosopher (which was what scientists were called in those days), but he was elected to the Royal Society not for his discovery of oxygen but for his research and writings on static electricity; and, finally, he wrote rather extensively on psychology, a subject in which he was profoundly influenced by a man named Hartley, who apparently was one of the first to approach psychology as a science.

None of Priestley's professional activities by themselves should necessarily cause the ACS any great concern, and certainly the discoverer of oxygen could be claimed to be a chemist, regardless of what was written on his union card. What might cause more concern is the undisputable fact that Priestley was a very substantial thorn in the side of the Establishment. He was raised a strict Calvinist, but as a minister he was soon regarded as "unsound on doctrine." In fact, his religious beliefs became radical, and he was the godfather, if not the father, of the modern Unitarian Church. He waged a vigorous battle with Parliament and the Church of England for religious freedom. He fought so that those who were nonconformists to the doctrines of the Church of England could be admitted as students to Oxford and Cambridge and also hold civil and military positions. He fought for educational reform; the then current school curriculum was, in his words, "an object of ridicule." Furthermore, he strongly supported both the French and American Revolutions, as well as movements



Published in the *Attic Miscellany*, London, July 1791.
DOCTOR PHLOGISTON,
*The PRIESTLEY politician or the
Political Priest.*

A revolutionary Joseph Priestley is depicted as "Doctor Phlogiston" in a 1791 political portrait.

to abolish slavery. He wrote a flood of books and pamphlets outlining his views on these subjects.

His enemies, of whom there were many, characterized him as "a damned rascal . . . a fellow of treasonable mind . . . 'Gunpowder Joe,' who sought to overthrow Church and King." He was even shunned by his Establishment Fellows in the Royal Society. The tension finally became so great that in 1791 mobs were incited to loot and burn his church and home. Finally he was glad to follow his sons and emigrate to America in 1794.

Today, all of us — liberal, conservative, or whatever — can applaud the causes for which Priestley fought: for religious freedom, for educational reform, and for personal liberty. But I think it would be wrong to assume that

'Gunpowder Joe,' transplanted to today's world, would be a contented middle-of-the-roader. I am pretty certain he would be an environmentalist; he criticized Paris, citing ". . . the narrowness, the dirt and the stench of almost all the streets." Priestley would surely not be a Marxist; he was too elitist for that. But his writings emphasized deep conviction to the principles of freedom of thought and freedom of inquiry. Today, those principles would certainly bring him into conflict with the creationists, with the religious right, with apartheid, with militarism, and indeed, with the forces of anti-intellectualism, repression, and injustice, wherever they might be found. A modern Priestley counterpart is my colleague, and past Priestley Medalist, Linus Pauling. I am glad that Linus is also associated with Priestley, not only for his contributions to chemistry, but even more for his adherence to the same high moral and social principles. Chemistry — indeed the world — needs more men and women, with not only the ideals of Priestley and Pauling but also with the same willingness to work to establish those ideals in a far-from-perfect world.

Having paid homage to Priestley, I guess I am expected to offer in the remaining minutes some pearls of wisdom or inspiration. I feel wise in only one respect, and in a way which will be probably not very inspiring. The fact is that, in looking back from near the age of academic retirement, I recognize that throughout my life I have been very fortunate, indeed downright lucky. And not just because I have had so many wonderful experiences as a student, postdoctoral fellow, faculty member, and university administrator; nor through being involved with the ACS, chemical industry, textbook publishing, the book series *Organic Syntheses*, the National Science Foundation, the National Academy of Sciences, as well as a lot of travel at home and abroad. I have had more than my share of being in the right place at the right time.

Let me illustrate. Having never been much good at physics or mathematics, I feel I was very fortunate to get started in chemistry during a period when it was a much more descriptive science than it is today; when a knowledge of glassblowing was more important than a knowledge of electronics or quantum mechanics; when slide rules and log tables were our computers; and when the fanciest instrument in the organic laboratory was a refractometer or possibly a polarimeter.

Those things I could understand.

Of course, a lot of other people were also fortunate in starting in chemistry in "the good old days," but I was additionally fortunate in starting my undergraduate work at UCLA in 1936. At that time, UCLA had no PhD program, but it was on the verge of getting one. As a result, UCLA was able to hire bright, young chemistry faculty eager to do research. And those faculty encouraged me to get into research early — in fact, at the end of my sophomore year. This was very important to me because, although I was no great shakes at course work, it turned out that I was pretty good at research and I loved it. Almost for the first time in my life, I did something really well.

With only a few master's degree candidates and a growing undergraduate enrollment, UCLA was also short on teaching assistants. And again I was fortunate, because I was allowed to be the equivalent of a graduate teaching assistant — in six different undergraduate courses. I was not the only one to profit from this particular golden period at UCLA. During that time, the school produced seven future members of the National Academy of Sciences and of those, two became Nobel Prize winners in chemistry, and two became presidents of the ACS. Not bad.

Although I finished UCLA with four rather decent undergraduate research publications, these were not enough to overcome a spotty scholastic record and get me admitted to Wisconsin for graduate study. However, Penn State was willing to take a chance, and I was again fortunate (even if for only a brief period because of the start of World War II) to work with Frank C. Whitmore — a remarkable organic chemist, who became a lifelong inspiration.

At the end of my war research UCLA had gotten its PhD program going, and I was fortunate again to have a really bang-up PhD project with William G. Young, who himself later became a Priestley Medalist. The frosting on the cake of my graduate period was to be able to interact in a very close way with Saul Winstein, a physical organic chemist of remarkable scholarship, imagination, and intellectual tenacity.

Then I was indeed lucky not to be offered a job at DuPont, but instead to go off to Harvard as a postdoctoral fellow, just at the time that R. B. Woodward was getting started there and when Paul Bartlett and Louis Fieser

were in their prime. It was a confidence builder to find out that a country boy from the far West could more or less hold his own among the Harvard graduate students and postdoctoral fellows. Bartlett and Woodward helped greatly to shape my perception of what one's objectives should be in research, and the Harvard year was a great experience. It was easy to appreciate how lucky I was to be there.

And yet, I certainly can't claim to have always recognized good fortune immediately when it came my way. Thus, I had hoped after my Harvard year to get a teaching position at Berkeley and was disappointed, even a bit dismayed, when the only opening turned out to be at MIT, where Arthur C. Cope was just beginning to revive and renovate organic chemistry. Getting in on the ground floor at MIT with a dynamic leader like Art Cope and colleagues like John Sheehan and Gardner Swain turned out to be good fortune beyond belief. And I was, and I am still, very grateful to MIT for the opportunity I was given there to get a research program under way. Admittedly, it was a bit ungracious to leave in 1953, but I felt I repaid MIT in spades by persuading Art Cope to sign up George Whitesides (Caltech PhD 1964) for a faculty position almost a year before he got his PhD at Caltech. Still, it was painful to leave Cambridge, just as another of my heroes, Frank Westheimer, was moving from Chicago to Harvard. But the culmination of my academic good fortune was to be offered a professorship at Caltech — a small institution, but one with a lot of clout. When I travel and meet people, they often ask how large the Caltech student body is. I always ask back — "How large do you think it is?" The answer usually ranges from 10,000 to 40,000 and the truth of about 1,800 comes as a shock. Caltech turned out to be the ideal place for me to do science.

Of course, I have had my share of missed opportunities. Somewhere around 1951, Richard Ogg of Stanford tried to convince me that nuclear magnetic resonance (NMR) spectroscopy was going to revolutionize chemistry. Being nearly illiterate in electricity and magnetism, I did not even understand what he was talking about. Four years later I was fortunate, in the course of my DuPont consulting, to have William D. Phillips show me what NMR could do when applied to specific organic structural and rate problems. Only then did I realize how right Richard Ogg had

been. At that point I didn't care whether I would ever know how NMR worked, I just knew it would solve problems that I was interested in, and with the help of Linus Pauling the Caltech administration, bless them, came up with the funds to buy the first commercial NMR installation in a university. And so I was able to ride the early crest of the NMR wave which has swept along through chemistry and biochemistry, as well as into medicine, with growing intensity and importance for almost 40 years.

I was also fortunate to be able to ride the early wave of the application of molecular-orbital theory to organic chemistry. The later molecular-orbital waves have gotten so big, so steep, and so hard to ride that I've been happy to stay on shore. Still, around 1950, Hückel molecular-orbital theory (the simplest kind) had been cleverly, and carefully, kept secret from organic chemists by the theorists. "Too tough mathematically for you guys" was the watchword. But, one day, I was lucky to look over the shoulder of my friend, William G. McMillan, one of the high priests of theory, and find to my surprise that he was using simple algebra to solve a molecular-orbital problem I was interested in. I said, "Hey, what's going on here? I can do that too!" Talk about being in the right place at the right time! So wisdom not only comes with good fortune. Sometimes you need good fortune to hit you over the head!

The modern era that I have lived through has had some very bad scenes: things like the Great Depression, the Nazi period, several disastrous wars, and the despoiling of our natural resources. Nonetheless, I feel grateful to have lived in the heyday of the Petroleum Age; to have been around when movies began to talk and when wireless communication went from crystal sets to color video; to be able to jet with abandon from coast to coast; to see the arrangements of atoms in space for molecules as complicated as proteins and viruses; to see closeups of the planets and their moons, from Mercury all the way out to Uranus, with Neptune soon to come; to see the back of the moon; to touch a lunar rock. I'm grateful that I've been around for all of this and more — before the crazies evaporate everyone but the few remaining deep-cave dwellers for no better reason than that some people live by simplistic slogans, such as "better dead than red" or "better dead than red, white and blue."

You may well infer that I have become a

nostalgia freak and perhaps even think that I have decided that science cannot go much further after I retire. Not so. I don't think we are anywhere near the limits of the capabilities of science. A lot has been done, but we are still only scratching at the surface. I am enormously excited about the potential of learning more about the nature of the universe — on the one hand, by exploring the cosmos with the aid of devices like the space telescope, gravity-wave detectors, and other goodies to come; and on the other hand, by trying to achieve an understanding of matter all the way down to the properties of those exquisitely minute entities that the physicists call "strings."

It is clear to me that chemistry has a very exciting future in all of this, because it is so close to us and so much a part of what we are that it immediately affects our lives. It is fabulous that chemistry is taking over research in such things as superconductivity, as well as design and synthesis of other super materials for all kinds of purposes. Furthermore, chemistry disguised as "molecular biology" is leading us down the road to understanding life. Ultimately, sometime, in some way, chemistry will even help us understand how we possess and use the marvelous gifts of cognition, of reasoning, of humor, of love, of appreciating in the small constrained way that we can, despite the pain and anguish we may feel at times, the miracle of being alive.

Perhaps I am fortunate in my optimism, but the future looks wonderful to me. But we must control the seemingly inborn, very stubborn defense mechanisms, which make us fear, and too often make us wholly intolerant of people who are at all different from the way we are — whether the differences be in language, geographic location, religion, color, political beliefs, or social status.

Finally, let me say that, besides a love of science and a love of freedom of thought, I share with 'Gunpowder Joe' Priestley another measure of good fortune — a wife, a daughter and three sons. As to wife, Priestley's own appraisal and expression of appreciation can hardly be improved upon. His words were: ". . . a woman of an excellent understanding, much improved by reading, of great fortitude and strength of mind, and of a temper in the highest degree affectionate and generous, feeling strongly for others and little for herself."

My thanks to her and to all of the others, here and elsewhere, who have made it possible for me to be here tonight. □