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Acceptance of the Distinguished Public Service Medal for 1994

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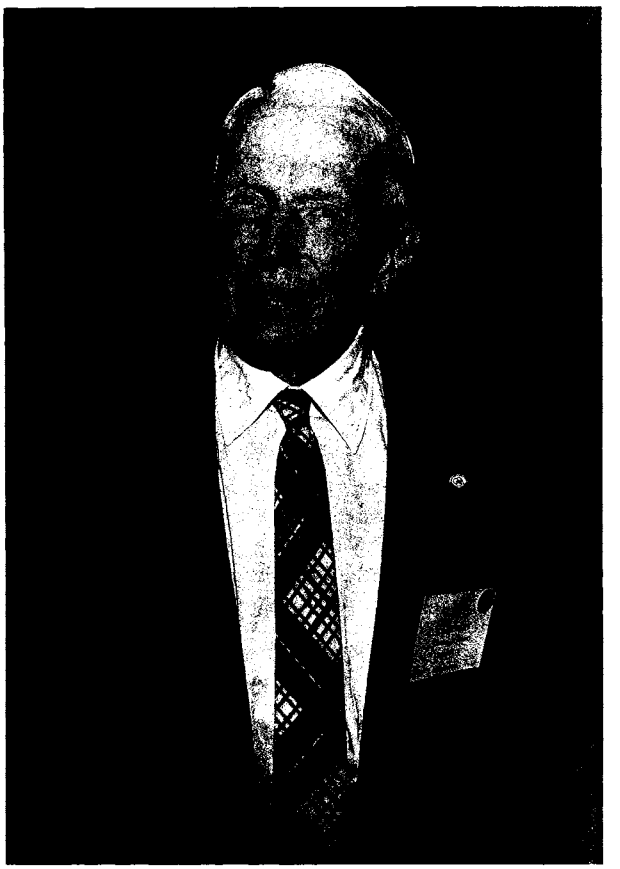
My thanks to Gordon for his flattering exaggerations, and my thanks to the Mineralogical Society of America for this most unexpected honor. To me it is a very special honor because the Society has reached beyond its boundaries to find someone who has done nothing of significance with minerals except to admire them at a distance.

And it's all most unexpected because much of the public service that is being rewarded has so far been of little consequence to the public. I refer particularly to work on the problem of trying to get rid of high-level nuclear waste, which Gordon described and which is about my only activity in recent years that can be properly called "public service." This problem, unhappily, is as far from solution today as it was when I first looked at it 25 years ago. What sort of public service is this when after a quarter century of effort by many people the only tangible result is great stacks of reports piling up on dusty shelves in Washington? The public, it seems to me, has every right to complain about this kind of service.

Of course I can fabricate an excuse by pointing out that the problem my colleagues and I tackled is a peculiarly obstinate one. This wasn't apparent at the beginning. We set out, in the early 1970s, expecting that in short order we would take care of a few technical details and the noxious waste would soon be safely underground. My companions in this enterprise were a changing group of experts from many fields; some of them were geologists and mineralogists but most were of other technical persuasions—engineers, physicists, chemists, soil scientists, and social scientists. To all these associates I express my deep indebtedness. They became good friends and quickly inducted me into the mysteries of nuclear waste. With this cluster of talent working on the disposal problem, the prospects for a quick solution seemed bright indeed.

But nuclear waste has some unfortunate properties. It is hot, it contains a variety of poisonous elements, and worst of all it gives out radiation. The radiation is not apparent to our senses but can do great damage to our insides if any substantial amount of the waste should escape into the environment. The intensity of radiation decreases with time, of course, but persists long enough that the waste remains dangerous for tens or hundreds of thousands of years. Public service in this context, then, is the effort to find a way and a place to bury the waste so that even over geologic times we can be assured that no appreciable quantity will find its way to the Earth's surface.

This seems simple enough. Dig a hole in the right kind of rock, put in the waste and cover it up, just as you would treat any kind of unpleasant garbage. Choosing the right kind of rock obviously needs some care because it must satisfy some stringent requirements. It must be located in a place where erosion is slow and disturbance from earthquakes or volcanic activity is unlikely, and it must not change or grow weak after long periods of heating and exposure to intense radiation. Groundwater moving through the rock must be scanty and slow moving, and its composition must be bland enough to prevent much dissolution if it comes in contact with the waste. And if some of the radioactive elements do get into solution, minerals in the rock should be capable of sorbing or precipitating them so that they will not move very far.



On such requirements are based the questions we grappled with in trying to perform our public service. The questions concerned matters of standard geologic and mineralogic detail, and we thought for a while that we had answered them. Yes, we could suggest several places

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where the rock is so durable, the groundwater moves so slowly, and minerals are so reactive with the more abundant radionuclides that we could confidently predict no appreciable escape of radioactive elements for at least a hundred thousand years. The goal of our public service, so we thought, had been achieved.

But the public, somehow, was not ready to accept our "service." Could we really guarantee that no geologic disturbance or no slight error in our calculations might permit some of the nasty elements to escape in the distant future? Of course we could not give this absolute guarantee. Always there would be some uncertainty, and the uncertainty was magnified by doubts loudly expressed by a few of our scientific colleagues. Now how does the public react when so-called experts disagree? With suspicion and extreme skepticism, of course; skepticism that is exaggerated here by visions of great clouds of mysterious radiation arising one day like those from nuclear bomb explosions or Chernobyl disasters. We could plead that the risk of such an occurrence is minute, far smaller than other risks we accept every day in ordinary life. But no use: the public wants nothing to do with nuclear waste, and every suggestion for a possible burial site is greeted with protests from those who live nearby. This leads, of course, to strong and persistent political obstruction.

So we arrive at our current strange dilemma. High-level waste could be disposed of tomorrow, with *almost* certain safety, but every place suggested for such disposal arouses immediate and loud political objection. Scientific assurance but not complete certainty; and a public confused by the arguments and not willing to accept minimal risk in the face of a poorly understood danger. It is a dilemma that starts with technical argument and drifts quickly into politics and sociology—a kind of dilemma we face all too often in the modern world. Let me remind you, for example, of the similar dilemma regarding danger from asbestos that was highlighted in previous Mineralogical Society of America award ceremonies.

And while we sit here wringing our hands, high-level radioactive waste continues to accumulate, with no solution for its disposal yet in sight.

It seems curious to me that public service should be rewarded when it has produced so little. And I find the award curious for another reason also. Why should one be honored for an activity that was overall more of a pleasure than a burden? Despite the long hours of committee meetings and report writing, despite the frustration of seeing so little return by way of positive result, I found the activity rewarding. Working on waste disposal was a new experience, a job that brought me in contact with new problems, new parts of the country and of the world, new and interesting people of many talents and backgrounds. Surely it was maddening at times, but overall the effort was stimulating, enriching, really enjoyable. Does such enjoyment over many years constitute a reason for being treated so handsomely today?

Anyway, the handsome treatment is much appreciated. I thank Gordon again for his kind remarks, and the Mineralogical Society of America for this unexpected and overly generous award.