

A Postterminaries in Three Movements

A premise: The R&D enterprise is sick. The patient's symptoms must be examined, a diagnosis must be arrived at, and a treatment must be prescribed before the patient dies. This month we tackle elucidation of symptoms and their interrelationships. In March, we search for root causes. Then, if the patient's insurance coverage is verified, the treatment and prognosis complete our visit to the doctor. We expect those hoping for a miracle cure will be disappointed. Homemade remedies may be sent to the MRS Bulletin as Letters to the Editor.

I. The Pathology of R&D's Modern Malady

To hear colleagues talk, many believe R&D now stands for *Relevance and Deliverables!* Beneath the light sarcasm lie many symptoms of a serious disorder. An anecdotal, inexhaustive list in random order includes the following observations:

1. Over the past decade, the more basic pursuits of several leading industrial R&D labs have fallen under the ax of short-term relevance to operating divisions.
2. Research benefactors are increasingly less benevolent—while we contend that our creative and innovative juices only flow in well-funded unfettered atmospheres, they demand more immediate relevance to applications, more predictability in our work, ever more frequent justification, and submission to added layers of oversight.
3. Member of Congress accuse us of being "naive and greedy."¹
4. Leaders in basic research fields complain more loudly than ever of tight budgets and project even tighter times ahead.
5. Government stands accused of making poor choices, be it Space Station Freedom,¹ the Superconducting Supercollider, or the ratio of defense to civilian R&D expenditures.
6. Articles and books about *managing* the creative process appear at an increasing rate, e.g.:

- A national laboratory director who longs for the less bureaucratic "good old days" writes a plaintive article in *The Atlantic Monthly* titled, "Managing the Unmanageable";²
- Another national lab author subtitles a recent article, "Research managers should aim to maintain an environment in which practitioners can be creative, and leave the choice of the object of research to the researchers themselves";³
- A book appears (*Managing Creativity in Science and Hi-Tech* by Ronald Kay, re-

viewed in this issue of the *MRS Bulletin*) which describes departures from normal management practice needed to run the R&D enterprise at the personal and organizational levels;

- An article in *The Scientist* titled, "Making the Transition from Bench Scientist to Lab Leader," focuses on our manageability and quotes a professor of management as saying, "Scientists have a greater-than-average desire for autonomy in work... [managers need] to know when to leave some people alone and let them do their own professional thing..."⁴

7. An inability to manage our own affairs is somehow blamed for the red flags rising over

- the science and math education of our children,
- slipping industrial competitiveness and associated trade deficits,
- our decreasing ability to translate basic research into commercial products, and
- scientific and fiscal integrity at our finest institutions.

8. The incoming president of the American Association for the Advancement of Science seems to tell government⁴ that funding for research should be viewed as an entitlement—the Administration and Congress respond by saying support for R&D must be justified on the basis of national needs.⁵

9. Our symptoms catch the eye and ear of the popular press,⁸ generating coverage that becomes a symptom in its own right.

10. And finally, we are reminded of our limitations in a short essay by Roald Hoffmann titled, "Why Scientists Shouldn't Run the World." He explains that our "rationality makes for good counsel but poor political leadership."⁷

This is a hodgepodge of troubling phenomena. One could cite many more apparently disjointed symptoms. Could they all derive from a single ailment? Diagnosis might be easier if we include in our data a view from outside. For that we must do our own hypothesizing, since we are not likely to value the opinion of non-scientist advisers on this particular subject.

Imagine you are in charge of new technology development at a large (read wealthy) company or that you are a manager at a government agency (read *very* wealthy) with a mission to fulfill, one that might benefit from an infusion of new technology. Now listen to the R&D facility's offer to help.

"Pay us now and every year for the foreseeable future in ever-increasing

amounts. In return we may be able to provide a product or service of unknown type, value and specificity, at some unknown time. Just trust us. We haven't let you down yet. We shall set our own project priorities and we believe it is quite likely that something we come up with will happen to coincide with a need of the company or the nation. And even if nothing useful pans out, we'll have expanded the sum of human knowledge and you should feel good about that. As an added bonus we will even train the generation that follows us to do business the same way we do. And, by the way, we would appreciate it if you would not ask for progress reports more than once a year, and please remember that it is the nature of our business to sell you one potential product and then switch midstream to a different one that seems more promising at the time."

Who could resist a deal like this?

Indeed, our words must fall this way on ears not inculcated in the research ethos. The symptoms reveal that we are chafing under the imposition of more stringent forms of "accountability" and feel grossly misunderstood and unappreciated. While we are described as difficult to manage by others, we claim management itself is anathema to the essence of our pursuits. It would appear that a sanity check is overdue.

One more observation may help our diagnosis. It is not just us and it is not just now. We apparently have a hereditary condition, perhaps dating from beyond natural philosophy to alchemy itself. For the pursuit we now call modern science, there is ample evidence that our ailment is systemic. To wit:

*Science! true daughter of Old Time thou art!
Who alterest all things with thy peering eyes.
Why preyest thou thus upon the poet's heart,
Vulture, whose wings are dull realities?*

from "Sonnet to Science"
Edgar Allan Poe

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1. *Science* 253 (July 19, 1991) p. 258.
2. "Managing the Unmanageable," R.P. Crease and N.P. Samios, *Atlantic Monthly* (January 1991).
3. "Research Management Today," J.J. Gilman, *Physics Today*, March 1991, p. 42.
4. *MRS Bulletin* XVI, (2) (1991) p. 15.
5. D. Allan Bromley as quoted in *MRS Bulletin* XVI, (4) (1991) p. 22 and 24. George E. Brown Jr., *op. cit.*, p. 11-13.
6. "Making the Transition from Bench Scientist to Lab Leader," K. Phillips, *The Scientist* (April 1, 1991) p. 18.
7. "Why Scientists Shouldn't Run the World," R. Hoffmann, *Issues in Science and Technology* (National Research Council, Winter 1990-91) p. 38.
8. "Crisis in the Labs," *Time* magazine, August 26, 1991, p. 45ff. □