Talking Points

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Event: Art & Science of Science & Technology Forum and Roundtable, Welcome Address

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Introduction

- It is a pleasure to be able to speak to you this morning at the Art & Science of Science & Technology Forum and Roundtable.
- From my perspective first as a research scientist and now as a leader of and champion for research, I find the subject of the *science* of science & technology fascinating, and I am delighted that Jeff Tsao has become interested in this area and has taken the initiative to organize this workshop; I very much look forward to participating in as much of the meeting as my schedule (and Jeff) allow and to hearing the outcomes.
- My perspective of science and technology, how they are done, and the environment that nurture them at their best has formed largely from my experiences at Bell Labs and here at Sandia.

My Bell Labs Experience

- When I think about my Bell Labs experience, one of the first things that comes to mind is the way the buildings were laid out. The cafeteria at the Murray Hill location was located in the middle of the huge building, and offices and labs were located along long corridors, largely along the one we affectionately called the "infinite corridor". This configuration, basically forcing everyone to walk along the same corridor to get from one point to another, made it inevitable that you would have multiple chance interactions with other scientists throughout the course of the day.
- Nearly EVERYONE went to the cafeteria at lunchtime, whether they bought food there or simply brought their lunch. The best tables were the large round ones, because it was always possible to squeeze in one more person. Sometimes the conversation was rather prosaic – politics, sports, and the antics of kids were familiar topics – but often the conversation turned to science.
- This was where the Bell Labs "stationery" (also known as a napkin) came in. It was often used to explore and then capture an idea that germinated during a conversation, which could be tried out in the lab that same afternoon. Several of my publications resulted from just such interactions.
- While there were scientists who were the world's authority on a wide variety of topics at every turn, the atmosphere was what I'd call irreverent and challenging. Bell Labs was not a polite or comfortable place. Technical debate was expected. If you were giving a talk or just engaging in a technical discussion around a coffee pot or in the hall, you expected that your ideas and data would be challenged. This forced you to think very carefully about your ideas and results BEFORE presenting them; you simply had to be prepared to defend them at great depth. All levels at the Labs, up to and including the Vice President of Research regularly engaged in these animated conversations. It was great fun – but it was not comfortable, and it was certainly not for everyone. There were some visitors who refused to give a talk there or, if they did, they fervently hoped that some of the most probing scientists would not be in attendance. What made the confrontation productive was that it was not personal – it was all about the validity and quality of the ideas and the data. Two people could have a "knock down, drag out" debate one afternoon and in the evening they and their families could have dinner together.
- In the days since I left Bell Labs, I have reflected on why it was so special. I think there are several reasons:
    - It was big – it had critical mass in many areas, so it was easy to find experts in a wide variety of fields

- Collaboration was both easy and required, since no one could build an "empire" of more than perhaps a technician and a postdoc, if that. In several areas, Bell Labs truly defined a technical field for a half century.
- It was part of the phone company, which had a LOT of fascinating technical problems to be solved. While most of us in the research part of Bell Labs did very fundamental research, our choice of problems was strongly influenced by these challenges.
- We had management who had extraordinary "taste" in research. They were technically excellent, performing their own personal research well up into the higher levels of management, and they could and did identify and nurture excellent ideas and sniff out ones that were mediocre or worse.
- Staff had nearly complete autonomy to try things – witness the afternoon experiments after a particularly interesting lunchtime conversation.
- At the same time, there was accountability. The annual performance review, as well as the periodic reviews of individuals by 3 or 4 levels of management, were not for the faint of heart. But at the end of the day, it was always about the quality of the science – as judged by other prominent scientists.

- *So what was it that enabled Bell Labs to do what it did? I think that it's because until divestiture in 1984, when AT&T was broken up by the Justice Department, Bell Labs was truly a national laboratory. This situation arose because AT&T was a regulated monopoly (a COCO). Taking the national lab image a little further, Bell Labs was paid for by a tax on everyone's telephone bill! Revenue was guaranteed in exchange for regulation of the businesses in which AT&T could and could not participate. This monopoly situation enabled Bell Labs, through the happy circumstance of highly enlightened leadership, to invest in research that would benefit not only AT&T and its business, but society as a whole. I can't help commenting, however, that one thing that differentiated Bell Labs from today's national laboratories was the fact that it never lost sight of the fact that it was part of a company, and a very large one at that. Being part of a private sector entity, even a regulated one, drove efficiencies that the national labs can only hallucinate about.*
- *Upon divestiture, change was inevitable. As AT&T tried to compete in an unregulated marketplace, the tyranny of competition, quarterly balance sheets and the like necessitated choices. The company could no longer justify long-term research that could benefit competitors as much as itself. It took quite a few years, but the fate of Bell Labs was sealed on January 1, 1984.*
- Although there were a few commonalities, the contrast with Sandia was stark.

My Sandia Experience

- When I arrived at Sandia, I experienced a large degree of culture shock. I had left a predominantly physics-based culture and had entered an engineering-based culture.
- Though Sandia's engineering products are very much rooted in science understanding, we are a problem-driven culture that is typically self-effacing, polite, and service oriented. That is VERY different from Bell Labs. Frankly, I think we need a more challenging atmosphere, though I'd be interested in your thoughts on that.
- The breadth of the mission at Sandia spans a wide range of national security areas. The core mission is, of course, the nuclear weapons program.
- At the very core of the nuclear weapons enterprise is the requirement that nuclear weapons must never, never, NEVER detonate when they are not supposed to – either through an accident or malfeasance. As you might imagine, this leads to extreme care in the choice of technologies for use in these systems – they must be demonstrated to ALWAYS work as intended and NEVER work in an unintended way. This, of course, means that they technologies must be thoroughly understood. That, of course, requires YEARS of discovery, development, maturation, and testing. And it also means that new ideas and technologies have an extremely difficult time making it into the nuclear stockpile. In short, the nuclear weapons program must AVOID risk if humanly possible and, if that is not possible, it must go to extraordinary lengths to mitigate any remaining risk.
- Sandia excels by bringing together a large number of very different disciplines to create one-of-a-kind engineered systems. It is when we do this – bringing together a wide range of scientific disciplines together with complex engineering, and ranging from fundamental discover to fielding entire systems – that we are at our best. While there are many examples of our success in doing just this, we don't manage it every time. What we need to do as we move into the future is to "bottle" the best of what we are as a Laboratory. And that means that we must understand what differentiates the times we are successful from those when we are less so. And we need to continually strive to raise the bar for what success means. It's a challenge that we are taking on even as we speak, and I hope that we can learn from your insights to become more successful.

Conclusion

- I, as well as the entire Sandia National Laboratories leadership team have embarked on a journey that promises to reshape the Laboratory. We are endeavoring to refocus on our greatest strengths, apply them to the Nation's most pressing problems, and continuously improve our ability to deliver solutions that provide "exceptional service in the national interest."
- It is in this context that I eagerly await the results of your two days of deliberation.
- Again, welcome to the Roundtable. I look forward to the insights and conclusions that will inevitably result.