

On Nurturing the Novel Neocortex

by Venky Narayanamurti*

We at Bell Labs have continued to come up with extraordinary innovations in the last five years — not just the last 10. The Karmarkar algorithm, new approaches to molecular beam epitaxy and devices, ultrashort light pulses, a megabit RAM, new single-frequency lasers, and high-capacity lightwave transmission systems are just a few examples which immediately come to my mind. Some of these achievements have already had an impact in enhancing AT&T's competitive position in the high technology arena. If history is any guide, more are likely to follow. In the ensuing, I give a personal viewpoint on nurturing innovation.

Innovation feeds on itself, and we are sure to see a continual stream of exciting new science and new technology. That's because our strength is in our *people*, in our explorers. They are the people Alexander Graham Bell would have enjoyed most. In fact, I often bring visitors, especially graduate students and postdoctorals, to Murray Hill to see Bell's statue where it says, "Leave the beaten track occasionally and dive into the woods — you will certainly find something you have never seen before."

But people don't just start innovating. People require an atmosphere where creativity can flourish, where ideas flow, and where personal development is encouraged. We at Bell Labs are fortunate that we are part of many decades of tradition in this area. I like to say that no one works for me, I work for my people. This is not meant to be just a cute line but is meant as a personal reminder that, even in a changing climate, today's managers must *nurture* — not manage — innovation.

It's tricky to create and maintain an atmosphere where ideas keep bubbling up. Such an environment is delicate, fragile and easily dam-

aged. Kumar Patel [Executive Director of Research Physics and Academic Affairs Division at Bell Labs] has often highlighted the three F's — Freedom, Focus, and Funding — as the basic ingredients which have led to a very favorable climate for research at Bell Labs. Using that as a springboard, I would like to talk about some underlying people-related issues — communications, freedom, and focus — which are crucial to the maintenance of a special environment.

First, communications. Managers and the scientists associated with them must feel free to talk to one another, or they're not going to get very far. Unless we can talk in a very open way, there can be no exchange of ideas. I certainly can't support, endorse, or evaluate what I don't know. And you can't know which direction to go if I don't give you feedback. When people know what is going on, they function much better. I find the best way of "reaching" people is through spontaneous interactions — in a scientist's "home" (his or her laboratory), informal lunch-time seminars, the physics tea-room, and corridor encounters.

Next comes freedom, especially the freedom to fail. If one is to be successful, one cannot be afraid to fail. Sometimes it is necessary to take several wrong steps before the right route is charted, but the learning that takes place in the process can be invaluable. Of course, there are obvious exceptions to this — astronauts and physicians, for example, have a very limited margin for error — but for the most part, intelligent people learn from mistakes. And each time you learn you grow. It will be the people who feel free to explore the uncharted regions of science and technology who will be successful.

Finally, the focus, which is seemingly in tension with freedom. In research the emphasis is

on freedom, but there should, depending on circumstances, be an awareness of focus, of providing knowledge in broad areas of interest to AT&T. The feedback is often of great importance to further progress in research. The transistor is a famous example of focused research, and our current work in the lightwave area is another more recent example. The focus, of course, becomes much sharper as we go to development; perhaps the toughest phase of a successful innovation is taking it from research and development on into implementation. Our culture strongly encourages the free, competitive spirit. In the early stages of research, open, friendly competition is good. In the implementation of the invention, however, one needs to channel that spirit for the corporate good. Managing this process is going to continue to make life at AT&T exciting for the next few years.

In summary, it is possible to maximize innovation by careful nurturing, but it can also be stifled by careless neglect. Our challenge for the future is to produce even more and better innovations than we have seen in the past through careful attention to the climate, to the people, and to the technology transfer. There are very few companies in the world that could experience the upheaval this company has endured and come away with their spirits intact. But we have done that, and Bell Labs has been a part of it. We should be proud of that.

**Venkatesh Narayanamurti, director of Bell Labs' Solid State Electronics Research Laboratory at Murray Hill, wrote this article for Bell Labs News early this month. He's leaving Bell Labs, where he's spent more than 19 years, to become Vice-President of Research 1000 at Sandia on May 1. The article is reprinted with the permission of Bell Labs News.*