The Idea Factory: Bell Labs and the Great Age of American Innovation

Jon Gertner
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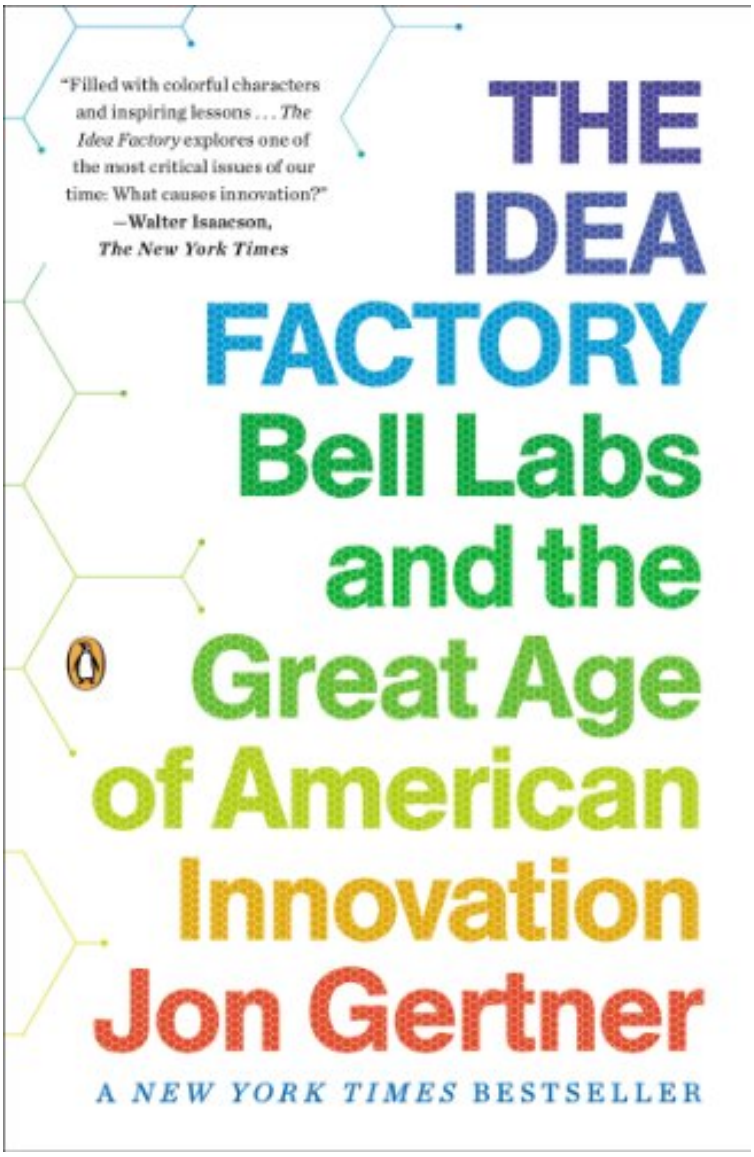

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Jon Gertner : The Idea Factory: Bell Labs and the Great Age of American Innovation before purchasing it in order to gage whether or not it would be worth my time, and all praised The Idea Factory: Bell Labs and the Great Age of American Innovation:

0 of 0 people found the following review helpful. Well-Written, Compelling History With Lessons For TodayBy CharlesJon Gertnerrsquo;s ldquo;The Idea Factoryrdquo; is a mild corrective to the commonly found anguished

certainty that Americarsquo;s days of innovative scientific greatness are behind us. In its exploration of the might and works of Bell Labs, this book reminds us that genius requires the right cultural environment to flourish, and it addresses whether collective or individual genius is the mainspring of scientific advancement. Ultimately, Gertnerrsquo;s account gives the obvious answermdash;scientific advancement stands on a three-legged stool, dependent on all of the broader culture, muscular group effort, and heroic individuals. Ayn Rand would not agree, but then, what did she ever actually accomplish?Todayrsquo;s ATT is the successor to the business created by Alexander Graham Bell in 1882. Before its breakup in the 1970s, the entire web of companies under the ATT umbrella was called the ldquo;Bell System.rdquo; It included various regional telephone companies, later called the ldquo;Baby Bellsrdquo;; Western Electric, which manufactured telephone related equipment; and, crucially for this book and for ATT, Bell Telephone Laboratories, officially created in 1925. Being a monopoly always offered both benefits and problems for ATTmdash;from early on, the company had an intermittently uneasy relationship with sectors of the federal government that opposed its monopolistic power and deemed it a threat to both competition and broader society. For the most part, though, ATT blunted these attacks with a strategy that emphasized cheaper and better customer service over time, which required continuously advancing the frontier of technology (thus the creation of Bell Labs); the free distribution of intellectual property; and a very close relationship with the government during World War II and the Cold War.The early years of Bell Labs were driven by Mervin Kelly, who spent his entire career there, from 1918, until becoming Director from 1951 through 1959. Kelly was responsible for much of the hiring and structure that made the efflorescence of Bell Labs possible. Although he was himself a vacuum tube expert, his real genius was organization. The goal of his organizational work was to ensure the overall success of ATTmdash;to improve the ldquo;systemrdquo; until it was ldquo;universal, economic and efficient.rdquo; Today we are used to both universal service and to a wide smorgasbord of other cheap and excellent communication methods, but offering low-cost, good, universal telephone service was a radical goal in the early 20th Century. Kelly was fully aware of the magnitude of the task, but also had little doubt that ATT could achieve it.Because Bell Labs was designed to advance the goals of the telephone system, all scientific work was ultimately done to address specific operational needs. At the same time, scientific work was encouraged that might not solve an operational problem immediately, or succeed at all, as long as it had, or might offer, some promise of relevancy to the overall goal of the system. Naturally, fixing one operational problem often not only improved service, but created, or revealed, another operational problem, the solution for which might involve an entirely new and different line of thinking, continuing the need to make advancements. Kelly viewed this practical need driving scientific research as a huge advantagemdash;his men, as Gertner says, ldquo;had the great advantage of working to improve a system where there were always problems, always needs.rdquo; Unlike todayrsquo;s tech magnates, Kellyrsquo;s goal was not to ldquo;break thingsrdquo; or ldquo;disruptrdquo; existing structures, and it most definitely was not to enrich himself or those who worked with him (although he did well enough to have a nice house). This was a more public-spirited time with a much more collectivist, in the good way, ethos.Among Kellyrsquo;s hires were Jim Fisk (instrumental in the development of radar and Kellyrsquo;s successor as Director of Bell Labs); William Shockley, Walter Brattain, and John Bardeen (the driving forces behind the invention of the transistormdash;Bardeen is the only person to have received two Nobel Prizes in physics); and Claude Shannon. Shannon was the developer of modern information theory, an utterly original set of ideas, including the reduction of communication ldquo;noiserdquo; through checksums, and also the author of a crucial 1945 mathematical treatise on cryptography. He additionally created a wide range of silly-yet-impressive inventions, including a calculator using Roman numerals, named THROBAC, which gives you a flavor of the Bell Labs environment. Through the 1920s and 1930s Kelly hired the best men, by offering both high salaries and prestige, moved them to New York, and put them in an environment of creative ferment. All Bell Labs scientific work was focused on experiment, but over time, as technology evolved, the tinkering aspects, such as endless methodical experiments to determine the best methods for cable sheathing, were supplemented by more theoretical physics, such as Shockleyrsquo;s research and writing a classic work, ldquo;Electrons and Holes in Semiconductorsrdquo;, exploring the physics of solid state materials.Kelly also oversaw the move of Bell Labs from its original crammed offices in New York City to much larger quarters at Murray Hill in New Jersey. For both Kelly and Fisk, physical proximity of people was key. The New York offices provided such proximity by stuffing everyone in one building, but the new Murray Hill building was deliberately designed for collaboration. Office and lab space could be shrunk or expanded with movable walls. Kelly forbade any scientist to close his door and required that even the most senior be willing at any time to entertain walk-in questions from others. Men working together had their labs and offices separated, so that they constantly had to walk a long way down the corridors, bumping into people and having unplanned, fruitful conversations. Throwing together scientists working in disparate technical areas ultimately proved critically important to the success of Bell Labs, in ways great and small. For example, Shockley worked in close physical proximity to several scientists whose focus was the apparently unrelated area of creating ultra-pure elements of various types, work that proved critical to the creation of the transistor, both for its physical material and for understanding the theoretical underpinnings of semiconductors. (I suppose this creative ferment is what the modern fad for open office layouts is supposed to accomplish, but I suspect that you have to have geniuses working for your

companymdash;otherwise, you just have created inefficiency and wasted time.)Gertner covers the origin of Bell Labs and the war years; then he spends quite a bit of time on what is almost certainly the most important invention generated by Bell Labs, the transistor. Kelly and Fisk immediately realized the economic importance of the transistor, even though they could not foresee its ultimate role in modern society. Their focus was improving their system; transistors could replace vacuum tubes (and other devices, too), but were vastly cheaper and better. But they also saw that the transistor would have many additional applications, and they knew that many of those applications were not visible to them. ATTrsquo;s ownership of Western Electric allowed the company to move transistors to mass production rapidly (a running theme of the book is the handoff of pure science to ATTrsquo;s development/manufacturing teams, which got less glory but were necessary to every success of Bell Labs). Critically, even before the transistor was perfected, Bell Labs shipped samples for experimental use to any scientist who asked, and ultimately shared the intellectual property with the entire world (both on principle and to insulate themselves from attack as a monopoly). Gertner also covers other postwar work, from development of the Nike anti-missile system, to solar cells (which only came into wide use after the decline of Bell Labs), to fiber optics, which were critical to the ultimate development of the perfected telephone system, though the materials science mostly came from Corning. (Fiber optics helped underwater transmission, although transatlantic cables were first, amazingly, done with copper, using vacuum tubes as the amplifiers/repeaters.) Failures such as the Picturephone, a classic example of groupthink, also get their due. And, finally, Gertner covers the forced breakup of ATT and the demise, for all practical purposes, of Bell Labs (although it still exists, legally, now as a subsidiary of Nokia). Probably its demise was inevitable, both because times changes, and because its guiding principal, improvement of the system, both was largely achieved and its importance largely eroded by other methods of communication.Almost all of the men profiled in this book (and they are all men) came from small town America, flyover country, with parents who were farmers, clerks, and housewives. Mervin Kelly came from Gallatin, Missouri; his father ran a hardware store. Claude Shannon came from Gaylord, Michigan; his father was a probate court judge. Brattain came from rural Washington State. Shockley came from Palo Altomdash;long before Palo Alto is what it is today. Thornton Fry, Bell Labsrsquo;s mathematical genius, came from Findlay, Ohio, the son of a poor carpenter. John Pierce (instrumental in satellite communication and the mind behind Echo, a huge metallized balloon in low-earth orbit used to test satellite communications concepts) grew up in Iowa. Yet these men became the giants that shaped the modern world. While many toiled in obscurity, many were widely recognized as geniuses at the time, both by the scientific community and by the popular mediamdash;more than one appeared on the cover of Time.This ascension of small-town Americans to positions of national prominence based on their intellect seems, at least in my impression, to happen much less nowadays. Why? First, I suspect the structures for identifying and elevating the promising in early and mid-20th Century America were better. As with the medieval church, local teachers could identify the promising, recommend them to others up the chain, and make it possible for them to both receive an education commensurate with their talents and find appropriate employment. Nobody, then, talked about ldquo;privilege,rdquo; believed in leveling egalitarianism, or wasted time on educational topics of no social value, such as Latino studies or the fantasy that the Constitution is at all based on the governance of the Iroquois Confederacy (something my eighth-grader today told me was being taught to him at his very expensive, and not progressive, school, an idea roughly equivalent to believing that the Sun is an egg for a monstrous alien). Instead, both teachers and students focused on advancement. For example, Cal Fuller, a Bell Labs chemist critical to semiconductor development, came from a poor family in Chicago. But his high school physics teacher knew that ldquo;the University of Chicago offered exams to high school students in science and math. She also knew that for those who passed, the university provided full tuition for the first year and, if you were among the top twenty-five students in your class at the university, for the following three years.rdquo; So she tutored Fuller nights for free and insisted Fuller pursue the scholarship, which he did, then going to graduate school ldquo;by working the four-orsquo;clock-to-midnight shift at the lsquo;Chicago Tribunersquo;.rdquo; With todayrsquo;s teachers torn between shrill demands to use gender-inclusive pronouns and to teach whatrsquo;s going to be on the next dumb federally mandated test, this sort of thing must happen much less today.Second, to the extent the intelligent and capable are identified, they rarely focus on the hard sciences. They are skimmed off into fields requiring far less hard training and offering far greater monetary rewards, yet which are largely destroyers of social capital, notably finance and law. Water flows on the path of least resistance, and why should our talented young be any different? Third, top colleges are now dominated by the children of our elite, who tend to marry each other much more than in the past, live on the coasts, and send their children to the same top colleges. They do this not so much to get an education as to get a credential that will allow them to pass the necessary filters and get jobs maintaining their position in the elitemdash;which, for the most part, does not include those with jobs in hard science. In the hard sciences, therefore, most students today are Chinese or Indian, who take their knowledge home and advance their societies. For all these reasons (and perhaps others), even though our population is larger today, we appear to have fewer home-grown geniuses, and they are less prominent. Whether that means less absolute scientific advancement is less clearmdash;maybe scientific breakthroughs are less obvious to the average person than they were decades ago, because earlier advances have made todayrsquo;s advances more specialized and harder for the layman to understand.

I suspect that if we had the old system wersquo;d have a lot more advancement, though.Bell Labs scientists not only worked closely together; they frequently socialized together, although many had odd, difficult or intensely private personalities that made such socializing probably less than glittering. Their work efforts were, as Gertner says, ldquo;group efforts, a compilation of the ideas and inventions of individuals bound together with common purposes and complementary talents.rdquo; It could not really be otherwise, given that their overall goal was improving the telephone system. But at root, all critical breakthroughs were individual breakthroughsmdash;as Kelly said, ldquo;With all the needed emphasis on leadership, organization and teamwork, the individual has remained supremedash;of paramount importance. It is in the mind of a single person that creative ideas and concepts are born.rdquo; Surrounding all this, of course, was a forward-looking, optimistic America, focused on individual and societal progress without a morbid fear of risk or cost. Viewing old ldquo;Twilight Zonerdquo; episodes, for example, will give you a sense of how America thought, and it is very different than the way America thinks today. It was the combination of these thingsmdash;group effort, individual effort, and the national culturedash;that enabled the achievements of Bell Labs.Gertner ends with an excellent question. ldquo;Regrettably, the language that describes innovations often fails to distinguish between an innovative consumer product and an innovation that represents a leap in human knowledge and a new foundation for industry. . . . [A]re we will living off the dividends from ideas that were nurtured, and risks that were taken, a half century ago?rdquo; Probably the answer is ldquo;yes.rdquo; I think that the existence and accomplishments of Bell Labs are in many ways a reproach to the extreme libertarian model that has taken hold of much of United States industry today. You donrsquo;t have to be a syndicalist or a Chestertonian Distributist to see that a model of close cooperation between a technology-focused company and the government, with the scientific results shared with all other comers for a nominal fee, rather than locked up by patents and legions of lawyers, accompanied by an ethos of public benefit (and lacking the parasitism of the ldquo;diversity and inclusionrdquo; crowd), is in many ways superior to the social utility-reducing quest for monopoly beloved by such men as Peter Thiel. It is not the case that everything that is not purely libertarian is crony capitalist. In fact, much of what is proudly libertarian is actually totally crony capitalist (see, e.g., Musk, Elon). Of course, the glory days of Bell Labs was a unique time, with easier, cheaper breakthroughs; a completely different government and ruling class; and World War II and the threat of global Communismmdash;but then, every time is unique. Maybe, or probably, the exact same setup wouldnrsquo;t yield the same dividends today, but this book still has important lessons for us, among them that a search for a system that *will* yield such dividends is very worthwhile.0 of 0 people found the following review helpful. Brought back memories!By James WilsonI absolutely loved this book. I was in telecommunications for over 10 years contacting for GTE at Sandia Laboratories - (once managed by an arm of Western Electric and Bell Labs) and I managed a Lucent / ATT 5ESS. Reading about all of this made me feel nostalgic and a little sad. Technology has moved so fast, that it seems the old equipment, technicians and Switch engineers have been replaced by machines and forgotten. My company, GTE merged with a baby bell, Bell Atlantic and became Verizon. I just somehow feel connected to all of these great inventors who started my career path right out of high school. My first training was at a lab in Atlanta, GA called Lucent technologies and I learned how fiber was made, and was certified to pull, splice and install fiber. I eventually worked my way up from the manholes into the switch, then accepted a job running networks for Kirkland AFB. The progression in communications is always spiraling upward and gave a person like myself a career with no ceiling. I am grateful for their tireless efforts and labors and feel indebted to their genius. I am in awe of the brilliance of these men and women and I absolutely loved the book. A trip down memory lane for me!! Thank you!0 of 0 people found the following review helpful. Loved itBy Michael H.I am going to give this one 5 stars .. There's an element of genius in taking such a fertile story and stuffing it between the pages of a book, and the story is told pretty well. I found myself caring about the various players. There was enough technical detail to warm my little geek heart, and the story managed to elicit the sort of guileless hero worship that is a) no longer in fashion and b) not age appropriate for this reader. It even has drama, in the form of William Shockley, whose life story was a somewhat checkered mix of the inspirational and the cautionary.My only beef is that I'm a little spoiled now. I haven't come across a book in the last few weeks that compares. I'm sure I will, eventually, but when a book leaves you dissatisfied with most of the books that follow, then you know it was a pretty good book.

From its beginnings in the 1920s until its demise in the 1980s, Bell Labs-officially, the research and development wing of ATT-was the biggest, and arguably the best, laboratory for new ideas in the world. From the transistor to the laser, from digital communications to cellular telephony, it's hard to find an aspect of modern life that hasn't been touched by Bell Labs. In The Idea Factory, Jon Gertner traces the origins of some of the twentieth century's most important inventions and delivers a riveting and heretofore untold chapter of American history. At its heart this is a story about the life and work of a small group of brilliant and eccentric men-Mervin Kelly, Bill Shockley, Claude Shannon, John Pierce, and Bill Baker-who spent their careers at Bell Labs. Today, when the drive to invent has become a mantra, Bell Labs offers us a way to enrich our understanding of the challenges and solutions to technological innovation. Here, after all, was where the foundational ideas on the management of innovation were born.From the Trade Paperback edition.

ldquo;[F]illed with colorful characters and inspiring lessons...The Idea Factory explores one of the most critical issues of our time: What causes innovation?rdquo;mdash;Walter Isaacson, The New York Times Book