Andrew Robinson

Ringing changes on vital information

Science Museum, London

Transformative
Like many new technologies, the telephone took a while to be considered a technology in its own right, rather than an update to the electric telegraph.

The Information Age: Six Networks That Changed Our World
Ed. Tilly Blyth
2014 Scala/Science Museum £35.00hb
224pp

Those of us who have lived through the past two or three decades cannot help but be amazed by the revolutionary transformation of communications, both in scientific research and in everyday life. But how does one convey this defining phenomenon of our time in a museum exhibition? After all, the fascination of computers and mobile phones lies mostly in what their software can do, rather than in the external appearance of the hardware – despite the endless efforts of designers and advertisers to persuade us otherwise.

This was the problem the Science Museum in London faced when planning its permanent new gallery on "The Information Age" and in compiling the general-interest book (published under the same title) that acts as a companion to the exhibition. As Tilly Blyth, the museum's keeper of technologies and engineering, confesses in the book's introduction, "There is something fundamentally contradictory and incongruous about 'capturing' or 'displaying' the information age in a museum. What is the meaning of displaying an information machine, if the information it carried or processed cannot be seen?" By way of analogy, observing the players in an orchestra is a lot less satisfying for an audience than hearing them play music.

Both the exhibition and the book solve the problem brilliantly, though, each in a way that suits its medium. The exhibition displays 19th-century, 20th-century and near-contemporaneous objects (including a model of an Apple computer I discarded only in 2010!), mixed with information that moves, speaks and sometimes interacts with the viewer via screens, soundtracks and computer keyboards. The book, for its part, offers easily readable and authoritative text written by Blyth, her fellow curators and several outside contributors, including the journalist Tom Standage writing on telegraphy (a technology he dubbed "The Victorian Internet" in his 1998 book on the subject); David Attenborough on the introduction of colour television; and entrepreneur Mo Ibrahim on the spread of mobile-phone networks in Africa. Their words are illustrated throughout with numerous, well-chosen colour photographs of such ravishing three-dimensionality that some readers will feel like running their fingers over the wires of the first transistor (admittedly a replica) or warming their hands with the heat of thermionic valves. (But let's not become sentimental and nostalgic about childhood electronics…)

Both the exhibition and the book cover the last two centuries of information technology by dividing the period into six thematic sections (hence the reference to "six networks" in the book's subtitle). The first section, "The Cable", covers electric telegraphy, invented in the 1830s; the second, "The Broadcast", is about radio and television; the third, "The Exchange", concerns telephony; the fourth, "The Constellation", deals with satellite communications; the fifth, "The Web", investigates computer networks; and the sixth, "The Cell", is devoted to mobile and cellular networks. In each instance, the science behind the technology is explained (albeit more fully in the exhibition than in the book) along with its impact on society.

One persistent theme that emerges is that new technologies can require a long time to find their way in the world. For example, the telephone took until the 1970s – some 80 years after its commercial introduction into Britain – to realize its potential "to ease domestic isolation and sustain British women's relationships with family and friends", as historian Lucy Delap observes in her essay "Women and the 'telephone habit'". Indeed, when the telephone was invented in the 1870s, it was initially regarded not as an altogether new technology but rather as an improvement of the electric telegraph; Alexander Graham Bell's 1876 patent on the telephone was entitled "Improvements in Telegraphy". In a letter to potential British investors, Bell argued that "All other telegraphic machines produce signals which require to be translated by experts, and such instruments are therefore extremely limited in their application. But the telephone actually speaks."

Almost as surprising is that the scientists and engineers who founded the computing industry between the 1940s and 1960s did not foresee that personal computers would be useful to white-collar workers in offices; that vision arrived only in the mid-1970s with the founding of Apple and Microsoft. Lasers are not part of the book, but I was nevertheless reminded of how they were regarded as potentially useless for several years after their invention in the 1960s. Colleagues famously used to tease Charles Townes, one of the inventors, by calling the laser "a solution looking for a problem". As Townes admitted some four decades later, "The truth is, none of us who worked on the first lasers imagined how many uses there might eventually be."

Often, of course, the barrier to a technology's establishment is an economic one. In "Connecting Africa", Ibrahim – who was born in Sudan, but trained as an engineer in Britain with what was then British Telecom – writes of the impossibility of raising international finance for telephony in Africa in the 1990s, because of the continent's reputation for genocide, dictators and famine. But in the end, he notes, this failure had an upside: "The failure to build robust

fixed-line networks enabled African countries to leapfrog that technology and land firmly in the mobile age."

The book's only serious weakness might be said to be terminological, rather than technological. Exactly what do we mean by "information"? James Gleick, author of *The Information*, takes up the challenge of defining this slippery concept in his introductory essay "Information: the blood and the fuel, the vital principle". He deals well with how Claude Shannon mathematized the hitherto vague concept of information in the late 1940s, but then takes refuge in a hyperbolic comment by quantum theorist John Wheeler (of "It from Bit" fame): "What we call reality arises in the last analysis from the posing of yes/no questions." He also aptly informs the reader that "hardly any information technology becomes obsolete", citing the earliest information technology of all, written language, which remains crucial to communication. But then

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he seriously misleads by claiming that "The first code of all – the one that gave birth to all the rest – is the one we take for granted: the alphabet." Not only were the most ancient writing systems – the decidedly non-alphabetic Mesopotamian cuneiform and Egyptian hieroglyphs – invented a millennium and a half before the first appearance of the alphabet in Palestine, some current writing systems, such as those of China and Japan, did not originate from the alphabet.

That said, it is heartening to find the Science Museum and its publisher Scala still investing substantial money, time and expertise in an information technology that is so many centuries old. *The Information Age* is a book that will undoubtedly "inform, educate and entertain" – in the famous phrase of the first director-general of the BBC, John Reith – for many years to come.

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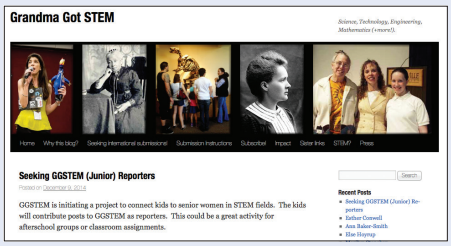
Web life: *Grandma Got STEM*



URL: http://ggstem.wordpress.com

So what is the site about?

Has anyone ever asked you to explain physics "in terms your grandmother would understand"? If so, did you ever stop to think that this might be just a tad unfair on those grandmothers who have, say, several scientific diplomas squirrelled away in their attics, or who started programming computers back when it involved vacuum tubes and punch cards and *actual bugs* crawling in and shorting out connections, so don't you come to me complaining about the battery in your smartphone, young lady, I mean, honestly, kids these days, tcha! *Grandma Got STEM* is a blog that collects and disseminates the stories of women like this, with the goal of inspiring the next generation and countering assumptions about the kinds of people who "get" science and technology.

Who is behind it?

The blog's founder and editor is Rachel Levy, a mathematician at Harvey Mudd College in California, US. She started *Grandma Got STEM* after becoming frustrated at the casual (but usually not malicious) ways that older people, especially women, are stereotyped as being unable to understand complex concepts in science, technology, engineering or mathematics (STEM). Most of the blog's entries are written by other contributors, who are often children, grandchildren or colleagues of scientifically minded women. Occasionally, the "grandmas" themselves contribute first-person accounts of their careers and experiences in science.

Who are some of the women profiled?

There are a few well-known names in the mix, including the physicists Lise Meitner and Maria Goeppert-Mayer and the crystallographers Dorothy Hodgkin and Rosalind Franklin. However, the real strength of *Grandma Got STEM* is the way it brings recognition to dozens of women who had perfectly ordinary scientific careers – ordinary, that is, except for the fact that they worked in fields that were (and in some cases still are) heavily dominated by men. A good example is an entry written by Gizem Karaali, a mathematician at Pomona College in the US who counts two STEM-savvy women among her forebears. One of them is her mother, Artemis Karaali, a chemical engineer and food scientist who recently retired from Istanbul Technical University. The other is her paternal grandmother, Selma Karaali, who earned a PhD in optics and spent most of her career as a physicist at Ege University in Izmir, Turkey. Karaali describes her grandmother as "the smartest woman I ever met" and recalls spending afternoons working with her on geometry proofs as a schoolgirl. When she took the proofs to class the next day, Karaali recalls, "if there were no volunteers to put the solution on the board for the problem, my teacher would ask: 'So Gizem, what has your grandmother to contribute to this discussion?'"

Are all of them actually grandmothers?

A few of them aren't – at least, not in the strict biological sense. One of the other physicists featured in the blog is Elizabeth Rona, a Hungarian-born nuclear scientist who worked with Frédéric and Irène Joliot-Curie in Paris in the 1920s and later on the Manhattan Project in the US. Rona never married and had no children, but the author of her entry on *Grandma Got STEM*, retired physicist Carl Helrich, remembers her as "a grand old lady of nuclear physics" and an inspiration to him and many other scientists at Oak Ridge National Laboratory, where she spent her later career.

I know a couple of STEM grannies. Can I write about them?

Of course! *Grandma Got STEM* is a collaborative project and Levy welcomes contributions from anyone with a story to tell about inspiring older women who work, or used to work, in a STEM field. If you like the idea, but can't think of anyone to interview, check out Levy's post from December 2014, which includes some tips about selecting interviewees and deciding what questions to ask them. She is particularly keen to get students to become "junior reporters" for the site by interviewing women in their own families or communities (it would make a great class project for almost any age group), and she is also trying to make the blog more geographically diverse, as the "grandmas" featured in it currently hail from only a handful of countries. Finally, it must be noted that there aren't many physicists yet in Levy's list of STEM-friendly grandmas. Surely this is a problem that *Physics World* readers can help solve?