

craft that flew 150 times without crashing. He conceived the idea of implanting radium in tumors to shrink them, founded the journal *Science*, experimentally bred ewes with extra nipples so they could suckle more offspring, and pondered global warming, which he named the “greenhouse effect.” The list goes on—not to mention that, as the son of one deaf woman and the husband of another, he considered his true life’s work to be the education of the deaf.

So innovating a life deserves a first-rate biography, and it has one: Robert V. Bruce’s *Bell: Alexander Graham Bell and the Conquest of Solitude* (1973). Although Grosvenor and Wesson do not change the contours of Bell’s career as Bruce mapped them, their text and captions provide a well-told, brief life of the inventor. They draw fresh material, too, from Bell’s huge correspondence, and they expand matters that Bruce treated in passing, especially the social effects of the telephone. But what sets apart their artbook-like volume are its 400 illustrations. More than half of them published here for the first time, they make an eye-popping pictorial commentary on Bell’s life and times. Many come from the thousand family photographs tucked in nooks and crannies of the Bell family home in Nova Scotia (Grosvenor is a great-grandson of Bell) or from 3,000 unpublished images of the phone industry in the early 20th century taken by the photographer Morris Rosenfeld.

Whether intimate or public, these unfamiliar illustrations have the spellbinding interest of the just-unearthed past. Here is the cabalistic-looking glove Bell used to teach a deaf boy, imprinted at fingertip, thumb, and palm with letters that could be touched to spell words. Through the window of a diving helmet we see the face of Bell’s adventurous wife, Mabel, as she prepared to descend underwater off Nassau. And, of course, everywhere the telephone. Early prototypes, some in glowing color plates: Bell’s “multiple harmonic telegraph,” his “liquid variable-resistance transmitter.” The succession of wrinkles and improvements: the first dial telephones, first nickel-in-slot pay phones. The transforming presence of the telephone on the American scene: a male operator seated at the San Francisco Chinatown switchboard, earphones braced over his long pigtail; a

hole-digging crew on the transcontinental line, working across the Nevada desert—in a covered wagon. And pervading all, the embryonic present. An early ad for the Bell system shows a long row of houses with open doors, and proclaims how, in connecting them, the telephone “provides a highway of universal communication.”

—Kenneth Silverman

**NUMBER SENSE:**  
*How the Mind Creates Mathematics.*

By Stanislas Dehaene. Oxford Univ. Press. 274 pp. \$25

Where do numbers come from? Do they exist outside human beings, or did humanity invent them? Do they somehow exist beyond space and time, as one of my old neo-Platonist philosophy professors intimated? Are numbers the specifications for the architecture of the universe? In this engaging book, French psychologist Dehaene maintains that numbers originated with humans. He argues for the existence of a rudimentary “number sense,” encoded by evolution into the genes and brains of humans and many other animals. Using this innate sense, humankind has developed mathematics—a cultural creation much like literature, architecture, or art.

Studies have found that rats, chimpanzees, and pigeons have a built-in “accumulator” that allows them to keep rough track of a limited number of objects, usually about three. Human babies have the same ability, which is subject to the same limitation. But humans soon pass beyond this rudimentary skill and learn to estimate, compare, count, add, and subtract. As indicated by new forms of neurological imaging such as the PET scan and MRI, these skills reside in the inferior parietal region of both cerebral hemispheres. The parietal lobe is also where the neuronal circuits for sound, sight, and touch appear to come together; in this regard, “number sense” may be more than mere metaphor.

To support his mathematics-as-human-invention thesis, the author shows how numbers have been created through intellectual effort. The most primitive languages have words for numbers only up to three. Dehaene traces the development of number notation, which enabled our ancestors to name and to count ever higher. Each

advance, he observes, showed “a small but consistent improvement in the readability, compactness, and expressive powers of numerals”—as in the shift from Roman numerals to base-10 Arabic numerals.

Physicist Eugene Wigner famously marveled at the “unreasonable effectiveness of mathematics in the natural sciences.” The efficacy of abstract mathematics in describing natural processes has led many thinkers to conclude that the universe must be constructed along mathematical lines. Dehaene, however turns this argument on its head when he asks, “Isn’t it rather our mathematical laws, and the organizing principles of our brain before them, that were selected according to how closely they fit the structure of the universe?” In other words, bad mathematics and bad mathematicians have been ruthlessly eliminated by the forces of cultural and natural selection. “Is the universe really ‘written in mathematical language,’ as Galileo contended?” asks Dehaene. “I am inclined to think instead that this is the only language with which we can try to read it.” In this book, he goes a long way toward persuading the reader that he is right.

—Ronald Bailey

### **ABOUT FACE.**

By Jonathan Cole. MIT Press.  
223 pp. \$25

Life begins with the face. A baby learns to distinguish its mother’s countenance from others within days of birth, then begins imitating her expressions. Through mimicry, the baby gradually discovers how to interact. Cole, a neurophysiologist who teaches at the University of Southampton in Great Britain, suggests that “the face is

perhaps most important in the first weeks and months of life.”

Cole also explains how evolution has refined the primate visage. From the simple respiratory function of cold-blooded vertebrates to the primate’s finely controlled matrix of muscles, the face has advanced to permit greater expression. When primates stood upright, the face became more visible. Instead of having to use the whole body for physical expression, creatures could manipulate a smaller palette, which offered communicative advantages: “The face was more private, allowing communication to be directed at groups or even individuals, and it may have been more eloquent, allowing the development of a different, more refined, sort of body language.”

In addition to signaling emotional states, facial expressions influence them. Researchers have found that when we smile or laugh, we feel happier. In a case study recounted in the book, a man’s personality grew less vibrant as his Parkinson’s disease progressed and he lost the use of facial muscles. His voice grew monotonous; his emotional range shriveled. When physical therapy revived some of the muscles, his voice and his personality were reanimated as well.

Although Cole’s compassion and curiosity always show through, *About Face* never quite coalesces. Lacking his friend Oliver Sacks’s deft touch, the author over-relies on long quotations and neglects descriptive detail. Still, the book includes many thought-provoking, poignant moments. In one, a man who lost his eyesight in middle age laments that he can no longer tell if his wife is smiling. “There’s no doubt that the loss of the face is a profound loss,” the man says. “A deeply dehumanizing loss.”

—Polly Bates