

## BOOKS &amp; ARTS

## Vision of a personal genomics future

The director of the US National Institutes of Health, Francis Collins, calls for a revolution in personalized medicine. Such advances should be shared beyond the developed world, says **Abdallah S. Daar**.

**The Language of Life: DNA and the Revolution in Personalized Medicine**

by Francis S. Collins

Harper/Profile: 2010. 368 pp/288 pp.

\$26.99/£15

We have entered the era of rapid, inexpensive genetic testing and genome sequencing. In the next decade, the cost of sequencing the full human genome will drop to a few hundred dollars, vastly less than the US\$3 billion that was invested in the 13-year Human Genome Project. But what should we do with all the knowledge that will be gained?

Francis Collins, the new director of the US National Institutes of Health (NIH), has little doubt: embrace a revolution in personalized medicine. Collins was the public face of the Human Genome Project. He stepped down in 2008 after 15 years as director of the US National Human Genome Research Institute (NHGRI) to write a book on personalized medicine for the public. His excellent treatise empowers readers to understand the revolution, make use of it and push for policy change.

*The Language of Life* is timely, current and full of moving stories: of the despair and hopes of his family, friends, colleagues and patients touched by developments in genomics research. Although it may come across as breathlessly optimistic at times, that doesn't diminish the joy of reading it. Collins argues convincingly that your DNA can become "your personal textbook" that "could literally save your life".

There is a lot of science in the book — why we are all flawed mutants, the genetic basis of cancer and how sirtuin proteins might influence ageing. He explains the roles of the genomes of trillions of microbes in and on our bodies (the microbiome), and the importance of the international HapMap project to unleash the power of genome-wide association studies. Insights from genomics research have uncovered fascinating molecular mechanisms of diseases such as chronic myeloid leukaemia, leading to rational drug designs.

Collins's writing is so deceptively lucid that you hardly realize you are receiving a serious education. The book's brave chapter on genetics and race is the best summary of this complex and emotive subject that I have read. There is humour too, as in learning that James Watson intentionally appeared before



M. BARTLETT/NHGRI

Francis Collins argues that each individual's genome is a 'personal textbook' of life-saving possibilities.

the US Congress as a dishevelled professor, with unkempt hair and untied shoelaces, to seek funding for the Human Genome Project.

One area that Collins might have emphasized more is genomics and global health. Writing in 2003 (see *Nature* 422, 835–847; 2003), he envisioned the future of genomics research as a house — but who will live there? Just the 700 million or so wealthy people in North America and Western Europe? Is there room for the 90% of humanity that lives in developing countries?

Collins is clearly aware of, and passionate about, global health inequities. He contracted tuberculosis as a medical intern in North Carolina and malaria as a missionary physician 20 years ago in Nigeria. As the director of the NIH, he has made it a priority to expand research into diseases that affect the developing world. The book might have highlighted more the identification of vaccine and therapeutic targets from the genomes of organisms that cause deadly diseases, or the development of vaccines through manipulating the genomes of parasites such as those that cause malaria. Other genomics challenges include engineering the human immune system to fight HIV and creating handheld point-of-care diagnostics.

Although *The Language of Life* isn't centred on him, a reader will learn a lot about Collins: the humane physician and scientist, the wise

and passionate advocate of rationality and common sense, the detective who was involved in discovering the genes and mutations involved in breast and ovarian cancer, cystic fibrosis, progeria, neurofibromatosis and Huntington's disease. At the NHGRI he prioritized ethics. He pushed to release raw sequence data from the Human Genome Project daily over the Internet as a global public good, and helped to pass the Genetic Information Nondiscrimination Act of 2008. As the NIH director, Collins is a worthy successor to Harold Varmus and Elias Zerhouni. But at an agency that encompasses 27 institutes and centres, 18,000 employees and a \$30-billion budget, Collins will have to be careful to balance genomics with other priorities.

Having undergone genetic testing himself, Collins divulges in the book his own disease predispositions as well as those of his family members. The susceptibilities of fellow geneticist Craig Venter, whose genome sequence has been published, are also mentioned. So is that of the co-founder of Google, Sergey Brin, who, as a client of the direct-to-consumer genetic-testing service 23andMe — co-founded by Brin's wife Anne Wojcicki — discovered that he has a higher-than-average probability of getting Parkinson's disease. Collins supports the availability of such tests, although he lists a dozen things to consider before taking one.

Such public announcements raise questions about privacy and confidentiality. Referring to digital technologies, Scott McNealy, chief executive of Sun Microsystems, once remarked, "Privacy is dead. Get over it." Could the same be said of genomics and genetic testing? We may soon be able to identify the owner of an anonymized DNA sample from little more than their genomic data. With the increasing power and plummeting cost of sequencing technologies, analysis, computers and data storage, the loss of privacy seems inevitable. We must rethink the ground rules.

Collins quotes former ice-hockey player Wayne Gretzky, whose father advised him to "Skate where the puck is going to be." *The Language of Life* tells you where the personal-genomics puck is headed. ■

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Administration with teeth was one indirect result of the efforts of Norris and Gettler and of the awakening consumer movement.

Prohibition proved a disaster, but ethyl alcohol was still the most important poison. As chronic alcoholism and alcohol-fuelled deaths soared, Gettler profited from the casualties by conducting more painstaking experiments, coming up with the first published scale relating blood-alcohol content to levels of drunkenness. In the course of his career he also helped to highlight the dangers of supposedly health-giving radium and 'illuminating gas' — a toxic mixture of carbon monoxide and hydrogen, and devised increasingly sensitive tests for the poisoner's darlings — arsenic and mercury bichloride — in the tissues of corpses.

When Norris became a medical examiner in 1918, scientific evidence carried little weight in the US courts. He died in 1935, probably of overwork. By the time Gettler retired in 1959, lawyers were complaining that the reputation of his toxicology laboratory in New York City was so great that as far as juries were concerned, his word was law. The United States's first university courses in forensic medicine were up and running, and had already generated his and Norris's successors. More than 300 people attended Norris's funeral, including the chairman of the state liquor authority. They realized that he had presided over a mini-Enlightenment. ■

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## The bootleggers' legacy

**The Poisoner's Handbook:  
Murder and the Birth of Forensic Medicine  
in Jazz Age New York**

by Deborah Blum

Penguin Press: 2010. 336 pp. \$25.95, £16.20

As Deborah Blum describes vividly in *The Poisoner's Handbook*, the catalyst for the birth of forensic medicine in the United States was Prohibition. Most people think of the nationwide banning of the consumption of alcohol in the 1920s as merely a failed attempt at social engineering. Yet, as Blum shows, it was an exercise in mass poisoning — self-inflicted and government-condoned.

Her two protagonists, New York City's Chief Medical Examiner Charles Norris and his chief toxicologist, Alexander Gettler, saw the problem coming from afar. Early on in the 13-year experiment to outlaw ethyl alcohol, bootleggers turned to its poisonous cousin methyl alcohol, also known as wood alcohol, to quench the nation's thirst. Norris and Gettler saw the results carried into the city morgue. To begin with, methyl alcohol causes the same pleasant feelings of inebriation as ethyl alcohol, but these are quickly followed by blindness, coma and death.

As one apparatchik tried to advise the danger-courting public, bootleggers are not your friends. But to the mystification of the authorities, even when people knew the risks, they continued to frequent the speakeasies. When the government saw that its "noble experiment" was in danger of failing, it decided that the problem was that methyl alcohol, readily available as industrial alcohol, didn't taste nasty enough. It put its chemists to work designing ever more unpalatable toxins — out of which creative bootleggers could be relied on to conjure hooch. If you won't learn, stern Uncle

Sam cautioned the public, then we'll make you sicker and sicker until you do.

In New York, Norris and Gettler were left to clear up the mess. They worked tirelessly, Norris supplementing his department's derisory budget out of his own, well-lined pocket. Gettler's meticulous experiments enabled him to work out the lethal doses and mechanisms of action of many an illicit cocktail ingredient.

Blum leaves her readers in no doubt that the two blazed a scientific trail. Before Norris's arrival in office, a milkman could be a coroner and sign death certificates, poisons were rife in household and cosmetic products, labelling was non-existent and manufacturers were not held responsible for any damage their products might cause. The creation of a Food and Drug



US toxicologists had plenty of work during Prohibition as bootleg drinks often proved to be lethal cocktails.

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