

Book

On the shoulders of giants

If I have seen further it is by standing
on the shoulders of giants

Isaac Newton, 1676

According to the *Oxford Dictionary of Scientific Quotations*, the famous quotation in a letter from Isaac Newton to Robert Hooke, which opens *The Scientists: an Epic of Discovery*—a delightful anthology of the lives and work of great scientists—has a long and varied pedigree. It has been traced back to Bernard of Chartres in the early 12th century and to the Roman grammarian Priscian. A later version followed in Robert Burton's *The Anatomy of Melancholy* in 1624: "pigmies placed on the shoulders of giants see more than the giants themselves". Since apparently Newton was aware of this version, and had an intense dislike for Hooke and some aspects of his work, he might have had Burton's version in mind when he wrote to Hooke. However, together with occasional revolutions and violent disagreements, science seems to have evolved in this way, generation by generation.

After paying homage to the natural philosophers of the ancient civilisations, the book's introduction by editor Andrew Robinson leads us to the work of the progenitors of the scientific revolution, notably Nicolaus Copernicus, Galileo Galilei, and Johannes Kepler. Discussing the latter's experiments, in which he showed that Aristotle's view of the nature of motion was wrong, Robinson quotes Albert Einstein who, three centuries later, wrote: "pure logical thinking cannot yield us any knowledge of the empirical world...because Galileo saw this, and particularly because he drummed it into the scientific world, he is the father of modern physics—indeed, of modern science altogether".

Based on this view of the beginnings of the modern era of science,

The Scientists is divided into sections, starting at the largest scale, the Universe, and then progressively reducing in size to the earth, molecules and matter, the subatomic world, and finally to the living world of plants and animals and the human body and mind. Each section has a short introduction and then a discussion of two or three of the major scientists

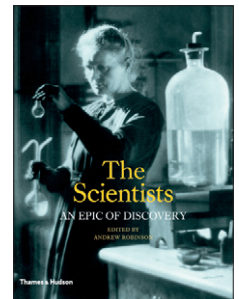
"Are there any hints about the qualities that produce an unusually remarkable scientist that can be deduced from this fine series of essays?"

involved. In each case there is a brief description of the life of the scientist, followed by an account of their work. Although medicine does not have its own section, the life and work of William Harvey and Louis Pasteur and others who had a major influence on the medical sciences are included under appropriate sections.

The choice of scientists and the juxtaposition of the excellent sections on physics and biology raise some fascinating questions relating to the "shoulders of giants" theme of this book. There seems little doubt that the founders of quantum physics like Niels Bohr and Erwin Schrödinger, as evidenced by their lectures and writings in the 1930s and 1940s which pondered on the difference between the uncertainties of the quantum world and the more predictable patterns of inheritance in biological systems, wondered if the latter might offer new areas for advances in physics. It is interesting to speculate on whether it was questions of this type that led to the movement of distinguished physicists like Max Delbrück, Gunther Stent, and Francis Crick into biology after World War 2 and

played such an important role in the scientific revolution that followed. It is more difficult to make these associations in the section on Body and Mind, which contains rather diverse bedfellows, ranging from Andreas Vesalius, Harvey, and Pasteur to Sigmund Freud, Alan Turing, and Louis and Mary Leakey.

But although they are often far from obvious or even seem contrived, such pedigrees in the advancement of science can undoubtedly be traced. For example, the work of Archibald Garrod, who is not mentioned in this book, and which was presented to the Royal College of Physicians in his Croonian Lectures in 1908 and later published under the title *Inborn Errors of Metabolism*, was undoubtedly the foundation of the field of medical genetics. For many years Garrod's work was completely ignored until the work of the Americans George Beadle and Edward Tatum on the bread mould *Neurospora* showed that the primary action of a gene is to direct the production of a specific protein, in this case an enzyme. In an address delivered in Stockholm, in 1958, on the occasion of the award of the Nobel Prize in Physiology or Medicine to Beadle and Tatum, Beadle wound up by saying: "in this long and roundabout way, first in *Drosophila* and then in *Neurospora*, we rediscovered what Garrod had seen so clearly so many years before". And less than 20 years later Vernon Ingram was to show, in his work on the structure of sickle cell haemoglobin, that the primary gene product is a peptide chain, work that was also, incidentally, one of the earliest intimations of the nature of the genetic code. Clearly, science has often followed many pathways that related to the scene set by workers of previous generations but there is no doubt that this pattern is broken from time



The Scientists: an Epic of Discovery
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to time by moments of individual genius, violent disagreements, and spectacular personality clashes.

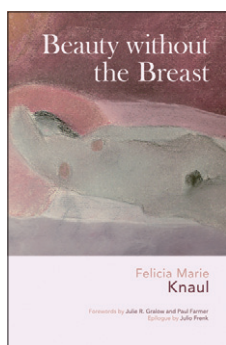
Are there any hints about the qualities that produce an unusually remarkable scientist that can be deduced from this fine series of essays? As pointed out by the editor, the scientists' nationalities, family backgrounds, education and training, together with their personalities, religious beliefs, and working conditions and circumstances, vary enormously. What they seem to have

in common is that they all worked habitually and continually at science and were remarkably prolific in their writing. Late in his life Charles Darwin is quoted as observing to his son: "Many men who are very clever—much cleverer than the discoverers—never originate anything. As far as I can conjecture, the art consists in habitually searching for causes or meanings of everything which occurs. This implies sharp observation and requires as much knowledge as possible of the subject investigated."

Newton, when asked how he had discovered the law of gravity, replied more simply: "by thinking on it continually".

This excellent celebration of the evolution of science over the centuries should be of broad interest to scientists and non-scientists alike—it will also be a wonderful stimulus to young people thinking about a career in science.

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Beauty without the Breast
Felicia Marie Knaul. Foreword by Paul Farmer, Julie R Gralow. Epilogue by Julio Frenk. Harvard University Press, 2013. Pp 375. US\$17.95. ISBN 9780982914410
For a review of *Tómatelo a Pecho* see [Perspectives Lancet](#) 2010; 376: 1135

In brief

Book **My altered self: cancer**

Having breast cancer instilled in Felicia Marie Knaul a resolve to use her personal and professional experience for the greater good. From the perspective of a patient, Knaul's book *Beauty without the Breast* is an intimate and detailed account of her life with breast cancer—or "altered-self" as she refers to herself with the cancer—from 2007 to 2012. The book is written in English and is a follow-up to Knaul's previous book *Tómatelo a Pecho*, a Spanish narrative of her first 20 months of life with cancer.

From the perspective of a health economist, Knaul wants *Beauty without the Breast* to encourage people to think about how an individual with a chronic illness moves through a health system. She also hopes to generate an advocacy movement through awareness of breast cancer to address other global health issues that affect women, including inequalities in access to health care and sex discrimination.

Knaul discovered she had breast cancer at the age of 41 years while living in Mexico. Although a terrible predicament to be in, she acknowledges in the book that the metaphorical abyss that she fell into was less deep and less dark

than that for many women with the same disease who are socially and economically less fortunate than herself. In theory, all women in Mexico have access to health care through Seguro Popular, a national public health insurance programme that has included breast cancer care since 2007, and are therefore better off than are women in other Latin American countries. However, the rates of deaths from breast cancer have increased steadily in Mexico since 1955, mainly because the disease is not detected and treated in time among low-income groups.

Sadly, late diagnosis of breast cancer seems to be a theme in low-income and middle-income countries, and women either die from a lack of treatment or are given radical surgery (mastectomy). Knaul describes how timely diagnosis makes a huge difference to survival: the 5-year survival for women with breast cancer is almost 99% if diagnosed early and treated versus less than 25% if diagnosed late.

For Knaul, her cancer has had some positive effects. Nowadays, she enjoys many more moments of happiness than she did before her "altered-self". Her husband Julio Frenk, the former Minister of Health of Mexico, did not abandon her when the going

got tough. Despite Knaul having a mastectomy and a swollen body, moon face, and complete loss of body hair from the chemotherapy, she was still beautiful to Frenk. The beauty he saw was manifested in his wife's struggle with her cancer. Frenk told me, "The experience provided me with a different perspective on the health system. I had spent all my professional life studying health systems as a researcher or reforming them as a policy maker. For the first time, I had the opportunity to look at a health system from the patient's perspective. In a sense, I went from leading to living a health system." When asked, Knaul told me that one of her messages to men whose partners are diagnosed with breast cancer would be that, "Physical beauty is short lived; sharing life is a different kind of beautiful."

Beauty without the Breast made me aware of, and angry about, the inequities in diagnosis and treatment encountered by many women with breast cancer who live in developing countries. The good news is that there are health leaders like Knaul and Frenk trying to address these inequalities.

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