PART 1

The Award and Beyond

CHAPTER 1

Commemorating Excellence: The Nobel Prize and the Secular Religion of Science

Jacalyn Duffin

About twenty years ago, I was frustrated by the way my history colleagues tended to ignore modern medicine, as if it was too boring or complicated for humanists to bother trying to understand. Without some demystification, I thought, the gulf between science and the humanities would grow wider, while mutually beneficial insights remained silo'd, inapplicable, and inaccessible.

As an experiment, I launched a seminar called 'The History of the Nobel Prize – Who Won It? Who Didn't? And Why?', focused mostly on the award in Physiology or Medicine. It seemed a good way to review medical achievements of the twentieth century – discoveries that once *seemed* new and important, whether or not they remain significant now. Resources were not lacking. Dictionaries, books, articles, and an ever-growing number of websites about Nobel laureates were abundant: some devoted to nationality, race, and gender. The Nobel Foundation's increasingly excellent, searchable website with its nomination database also helped. Historians, sociologists, and philosophers had already produced a robust secondary literature, using these resources and the Nobel archives.

The seminar class became a huge adventure. I learned far more from the students than they learned from me. They would choose a single Nobel Prize, research its history, explain their findings to classmates, and write an essay. As a final assignment, having heard their classmates' presentations, they were to write a second essay about a collectivity of prizes, defined by whatever parameter they chose: scientific topic, nationality, gender, etc. Consequently, I've had the privilege of hearing a detailed analysis of almost every Nobel Prize in Physiology or Medicine – sometimes more than once. It was a lot of fun.

During the 2009 semester, a student's grandfather, Willard Boyle, won the Nobel Prize in Physics for his work in digital photography; we watched her family's home movies about the ceremony. We had class visitors who were laureates – or had worked with laureates. Shifts took place in the students' own trajectories. A medievalist went to medical school; others bent on science ended up in history. We noticed themes and clusters of 'What Was Important' at different moments in time. We also observed that controversy tracks almost

 | DOI:10.1163/9789004406421_003

every award, if you scratch it deeply enough. And we began to marvel at the human *need* to venerate – an aspect of prize-giving that has received little attention. Each year the class awarded its own Nobel Prize to the best research presentation of the year; whether they were in agreement with the choice or not, the students applied their new knowledge of award-giving to explain their collective selection.

In the following essay, I will use my adventures with the Nobel seminar to reveal some insights about trends in medical science of the last 120 years. First, I will take a brief look at who and how many people or topics have won. Then, I review the prizes to identify themes in terms of topic and novelty – or 'paradigm shifts'. Chronological clusters of awards signal enthusiasms or new paradigms. Surprisingly to the uninitiated – but not this audience – achievements in medicine, with immediate therapeutic applications, were in the minority. Moreover, some prizes went to achievements that, in retrospect, seem unworthy. But the embarrassing 'errors' are just as telling of ambient priorities as the more durable awards, and they have influenced patterns of subsequent prizes. In closing I will comment briefly on prize-giving and celebration in general with reference to sociology and philosophy of science.

At the outset, I ran into two 'problems' in bringing non-scientist historians to research on Nobels. The Prizes celebrate *discovery*. But the concept of a 'Eureka-like' discovery is unfashionable among historians or philosophers – and with good reason. Every important discovery arises from another. New observations rarely turn out to be as original as they first seem; most are reformulations of old ideas.[1] Moreover, many discoveries emerge simultaneously by different workers in different places. Scientists are all chipping away at the same coalface.

Second, the prizes assign priority to individuals, sometimes undeserved, often contested, and frequently political. Yet – just as historians doubt the originality and singularity of discoveries, they have also become skeptical of celebrating individual actors of the past. Rather, they emphasize external forces that conspired to place a person in position to observe (or proclaim) something seemingly new. Furthermore, critics of histories featuring 'dead white males', on the one hand, or powerful elites, on the other, called for more attention to the ordinary, the obscure, the continuous and the marginal. As sociologists and philosophers of constructivist knowledge show, researchers participate in epistemic communities sharing questions across boundaries.[2] This perspective provoked a relative decline in scientific biography as a form

1 Grmek 1981.

2 These rising trends are exemplified by the founding of two journals: *Social Epistemology* in 1986 and *Episteme: a Journal of Individual and Social Epistemology* in 2004.

of scholarly analysis beginning in the late 1960s and early 1970s, despite its immense popularity with the reading public; this decline, labeled the product of a 'Cold War generation', has been questioned by Thomas Söderqvist, among others.[3]

The earliest Nobel committees discovered that a single year was insufficient to establish the significance of an achievement. Discoveries need time to gestate, to prove themselves for utility and durability. Consequently, committees deviated from the Nobel's will. The first prizes went to work completed much earlier – and that gap grew. The first medicine prize went to Emil von Behring for his work on serum therapy from the early 1890s. By 1905, Robert Koch was recognized for contributions to germ theory more than 20 years earlier.[4]

Soon, committees began to acknowledge the fact that most discoverers did not work alone. In 1906 and again in 1908, two scientists shared the medicine prize; by 1934 it was three (Figure 1.1). Since then, the awards can be shared by up to three people – sometimes collaborators, sometimes rivals. However having reached three individuals, no more were added, and sharing among three has become a 'rule' or convention. The increase in laureates for each prize over time reflects rising domination of teamwork, a well-studied phenomenon in history of science.[5] The number having 'stalled' at three has been a source of criticism, as if the prize has become 'a charming anachronism' that failed to keep up with the reality of scientific work. As Figure 1.2 shows, dividing the prize among individuals also made it possible to recognize achievement in two different fields; however, no more than two achievements have been recognized in each year. Posthumous awards are no longer allowed, unless the designated laureate has the misfortune to die between the decision and the ceremony. Ralph M. Steinman died three days before the announcement of his 2011 Nobel in Medicine and Physiology; the committee had been unaware of his death.

The demographic identity of laureates has been thoroughly analyzed by sociologists Harriet Zuckerman, Elisabeth Crawford, and others.[6] Winners are not randomly distributed. The majority are white males, from certain institutions in developed nations, participating in elaborate networks. A good way to be in line for the award is to work with a laureate. The advent of the searchable database drew greater attention and criticism over the extent of the demographic skewing that has disadvantaged women, nonwhites, and scientists in the developing world.

---

3 Söderqvist 2007, 13; Nye 2006; Zwart 2008.
4 Haddad 1999.
5 Wuchty, Jones, Uzzi 2007.
6 Lindahl 1992; Crawford 1984; Crawford 2002a; Crawford 2002b; Zuckerman 1967; Zuckerman 1978; Zuckerman 1992; Zuckerman 1996.

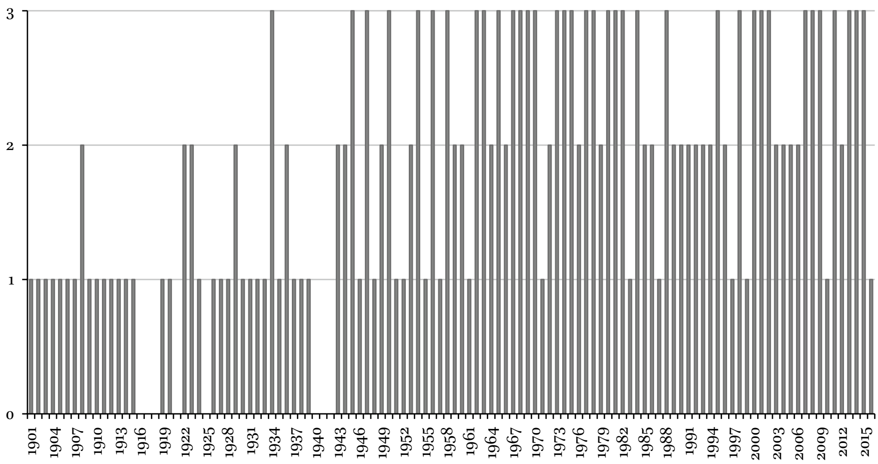

FIGURE 1.1 Number of People Honoured with each Nobel Prize in Physiology or Medicine

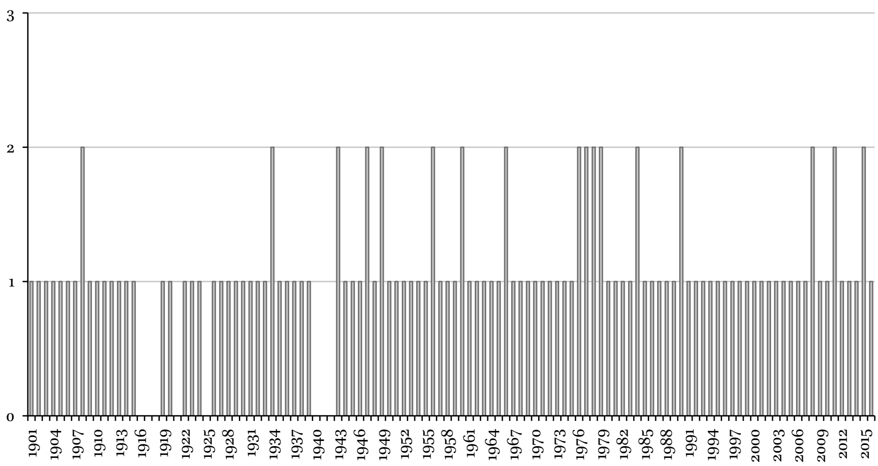

FIGURE 1.2 Number of Discoveries Honoured with each Nobel Prize in Physiology or Medicine

The combination of cautions – delay from discovery to award – and pressure to recognize scientists before they die – results in interesting 'push-pull' dynamics that impact choices. A recent article in *JAMA* of 3 October 2016 showed the increasing age of the laureates and the lengthening delay until recognition.[7] One author of this paper, Robert J. Redelmeier is an undergraduate student headed for medical school; he will return later in this paper.

7 Redelmeier and Naylor 2016.

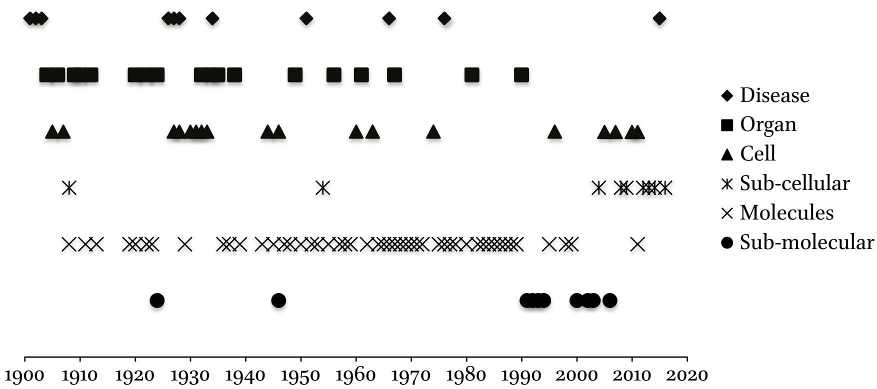

FIGURE 1.3 Focus of Nobel Prizes in Physiology or Medicine, displaying increasing reduction from diseases to organs to cells to molecules

Increasing Reductionism

A big trend in these prizes is toward greater reduction. Figure 1.3 helps to illustrate the change. The medicine prizes that have focused on diseases – that is the whole human organism or even populations – decrease in frequency. Figure 1.3 shows that the 2015 prize on disease is an interesting outlier. Next appear prizes that focus on organs, followed by those focusing on cells, cell components, and finally those that address molecules – be they physiological or pharmacological – or on little bits of molecules, such as ions. Molecular prizes went to familiar names from metabolic physiology – for example, Otto Meyerhof, Otto Warburg, Gerty and Carl Cori, and Hans Krebs. This exercise illustrates two things: first, the overall reductionist trend from 1901 to 2016 and second, perhaps a recent comeback in cell biology – something for us to watch and perhaps explain.

Persistent Paradigms

As a student, I read Thomas Kuhn and even heard him speak in Paris; as a young professor, I learned of and was drawn to the work of Ludwik Fleck.[8] Before launching the Nobel Prize-seminar, I labored under the illusion that Nobel-winning work – almost by definition – *must* be about paradigm shifts. Therefore, a way of analyzing the discoveries would be to uncover what shift each award had effected. But in the end, I realized that surprisingly few of

8 Kuhn 1962; Fleck 1979.

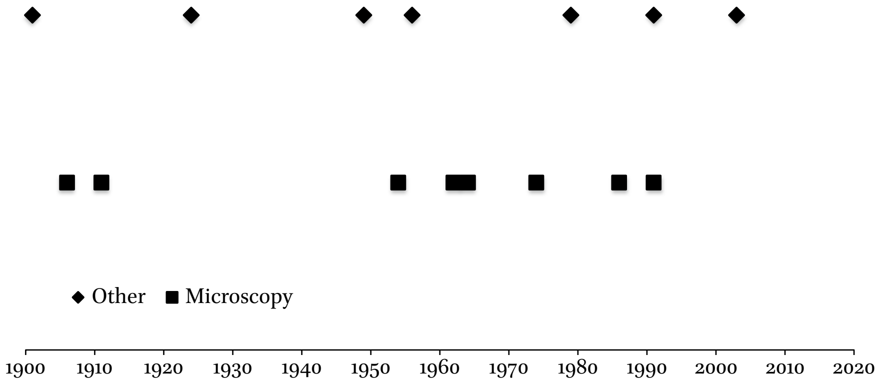

FIGURE 1.4 Nobel Prizes in Physiology or Medicine pertaining to the persistent paradigm of 'visualization'

these achievements resulted in major paradigm shifts. Instead, the vast majority merely extended and endorsed intellectual agendas of previous decades. Considerable overlap exists within these themes, and some achievements belong to two or more. Two examples of extended paradigms will illustrate this observation.

The first example is the set of prizes in what I call 'visualization' – achievements dedicated to making the invisible visible (Figure 1.4). One of the great achievements of the nineteenth century was 'anatomoclinical' medicine. Constellations of symptoms were linked to organic lesions that could be detected inside a living patient by tools, such as the stethoscope, pleximeter, microscope, and later X-rays. Rudolf Virchow extended visual pathology microscopically to the cell (he was nominated, but never received the prize). This view still dominates medical thought and disease concepts.[9] Figure 1.4 includes a few Nobel Prizes from medicine and beyond to emphasize the point. In 1901 Wilhelm Conrad Roentgen was awarded the first Nobel Prize in Physics for his 1895 discovery of X-rays. Many creative adaptations were developed quickly, such as fluoroscopy, tomography, and the use of contrast media. Angiography is another X-ray technique was awarded the Nobel Prize in 1949.[10] Without belabouring details other prizes in the realm of visualization include 1906 to Camillo Golgi for the structure of the nervous tissue; 1911 to Allvar Gullstrand for dioptrics of the eye and invention of the slit lamp; 1924 to Willem Einthoven for the electrocardiograph; 1956 to Werner Forssmann, André F. Cournand, and Dickinson W. Richards for cardiac catheterization.

9 Kevles 1999.

10 Howell 1995; Risse 1999, 569–618; Stevens 1999, 171–199.

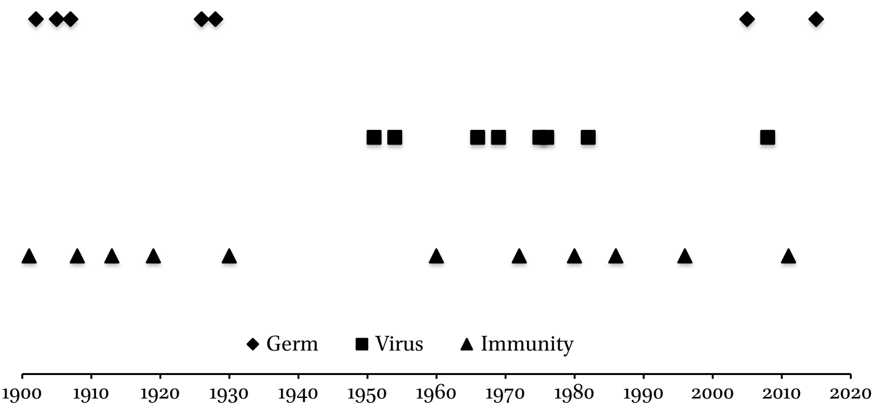

FIGURE 1.5 Nobel Prizes in Physiology or Medicine related to persistent paradigm of germ theory, including bacteria, parasites, viruses, and immunity

Microscopic visualization enters into this pattern too. Originating in the seventeenth century with technical improvements throughout the nineteenth century, microscopy enjoyed several Nobels proclaiming its continued importance into the twentieth century. In 1906, although Paul Ehrlich's Nobel Prize came for his side-chain theory, hematologists remember him for the stains that he devised for *seeing* white blood cells. A cluster of prizes in medicine and chemistry celebrated X-ray crystallography and its applications in 1954 and 1962 to Linus Pauling, Dorothy Hodgkin, Max Perutz, John Kendrew, James Watson and Francis Crick. The latter pair's famous structure-of-DNA achievement relied on the crystallographic images of Rosalind Franklin. Visualization can also be found in prizes for imaging: 1979 to Allan M. Cormack and Godfrey N. Hounsfield for Computerized Axial Tomography (CT-scan) – another extension of X-rays; 1986, to Ernst Ruska, Gerd Binnig and Heinrich Rohrer (Physics) for electron and scanning-tunnel microscopy; and 2003, to Paul C. Lauterbur and Peter Mansfield for Magnetic Resonance Imaging. The 2003 prize also evokes other Nobel Prizes in Chemistry and Physics for nuclear magnetic resonance in general.

Without diminishing the brilliance of these achievements, the medical paradigm served by these visualizing technologies was not new to the twentieth century. Rather they proclaim its wide acceptance by the scientific community and the general public: diseases are of the body and its components – anatomy, organs, cells, and molecules: doctors should be able to 'see' things that patients cannot. The celebrated contributions were Kuhnian 'normal science' refining technologies and possibilities within the paradigm.

The second example of prizes that serve a paradigm originating well before the twentieth century are those predicated on germ theory (Figure 1.5). With origins in the sixteenth-century writings of Fracastoro, the notion of a specific contagion is said to have been widely accepted by the 1880s. To bacteria, parasites, viruses and prions, we can also add prizes on immunity. The idea that surviving a specific contagious disease could convey passive immunity against future illness is evident in Thucydides' account of the plague of Athens of the fifth century B.C. Since the eighteenth century, *active* immunization had been shown to prevent smallpox. As already mentioned, the first Nobel Prize in physiology or medicine went to von Behring for 'serum therapy' against diphtheria – a dreadful scourge that killed little children by horrific choking; scientists and the general public were well satisfied with this award, which helped to launch the prestige of the new prize.[11] Two early prizes went to malaria (1902 and 1907) and one to typhus (1928), while the precipitous prize in 1926 to Johannes Fibiger for his soon-to-be-discredited work on the infectious cause of cancer. Far from waning, the germ theory paradigm saw the 2008 prize go to the AIDS virus. The 2005 prize given to the bacterial cause of peptic ulcer disease, pulled that disease concept out of twentieth-century psychoanalysis and plunked it squarely in nineteenth-century germ theory. Prizes on vaccines and other immunological achievements also stem from concepts originating in germ theory or earlier.

Even as they provide a fuller understanding of self-defence, viruses, prions, and many previously unknown pathogens, the numerous Nobel Prizes in the realm of infectious causes of disease and immunity reflect the persistence of an old paradigm.

Clusters and New Paradigms?

In contrast to the marked persistence of old paradigms, a few clusters of awards allow us to consider the possibility of new paradigms. Many different clusters can be identified, but again two examples will illustrate the point; both have qualitative roots in antiquity.

The first example is vitamins. With hormones they can be thought of as early 'Magic Bullets', although the vitamin prizes were more for physiological understanding of metabolism than for therapeutics. The phrase 'magic bullet' was used by Ehrlich as he tested dyes, hoping to find one that would magically target and kill bacteria (bullet) without also killing the host (magic).

As the ancient physiological explanations of body function were being transformed into precise chemical reactions, scientists turned to diet. After all, Hippocrates had understood the importance of diet in health and disease.

11 Luttenberger 1996.

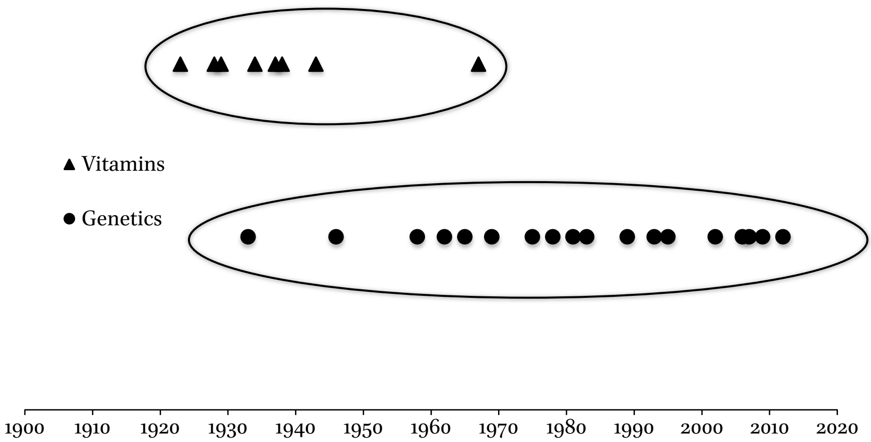

FIGURE 1.6 Nobel Prizes in Vitamins and Genetics Demonstrating Clusters

Furthermore, in the 1740s British naval officer James Lind had shown the value of citrus juice in preventing scurvy.[12] Dismantling and analysis of foodstuffs would further explain how the body keeps itself alive and well maintained.

Reductionist, molecular, and laden with therapeutic promise, the tight cluster of vitamin prizes in medicine and also chemistry – for discovery, isolation, elaboration – suggests a new paradigm (Figure 1.6). The word vitamin(e) was coined by Casimir Funk around 1912 to express the idea that tiny components of food (*amines*) were essential to healthy life (*vita*). Christiaan Eijkman found that brown rice prevented 'beri beri' that afflicted eaters of polished rice. Vitamins meant that several other diseases – scurvy, pellagra, rickets, kwashiorkor, or sprue – might be owing to as-yet-unidentified dietary deficiencies; they were previously considered infectious because they arose in localized outbreaks. They shifted to metabolic.

The second example of a possible new paradigm is molecular genetics. Hereditarian views of health and disease also go back to antiquity. Modern genetics transformed and reduced the ancient, descriptive notions of heredity, identity, and susceptibility into precise chemical formulae. Mirko Grmek referred to it as the third revolution in concepts of life and disease – a new paradigm – for its total reliance on molecules and data.[13] More Nobel Prizes have been awarded in this domain than in any other, particularly in the last fifty years (Figure 1.6).[14] Around 1900, a priority dispute over the notion of inheritance of

12 Bartos 2015; Lind 1753.
13 Grmek 2001; Grmek 1999; Burke 2012, 264.
14 Keller 2000.

independent characteristics led to the appreciation of the earlier observations of Gregor Mendel.[15] A century later, the Human Genome Project was set to report on the entire genetic code (completed 2003).[16] Between these two (as yet) *non*-Nobel moments, qualitative ideas were molecularized.[17] Nobel Prizes in Chemistry also recognized work in genetics: recombinant DNA and the invention of the polymerase chain reaction (PCR).

Genetics proved so attractive early in the twentieth century that, in the form of eugenics, it was applied as a kind of scientific benediction to racist policies.[18] It can be no accident that T.H. Morgan received his Nobel for chromosomes in 1933 – the same year that Adolf Hitler was elected to power in Germany. For its scientific status, eugenics was also used in many other countries too, including my own.[19] After 1945, a horrified reaction against eugenics led to funding problems for all genetics research; however, its applications in family planning – including laureate Robert Edwards' work with in vitro fertilization – helped to redeem its status.[20] Having endured the slings and arrows of politically motivated failures and abuses, some genetics laureates became articulate champions for the value of research and public ownership and access to information.[21]

The precise genetic error has now been identified chemically in a wide array of human diseases, such as Tay-Sachs, sickle cell, cystic fibrosis, muscular dystrophy, and several forms of cancer. Even diseases not thought to be hereditary are proving to have genetic correlations – but genetic engineering, or applications remain elusive.[22]

Prizes in Therapeutics

Until this point, the prizes I have discussed are mostly to do with physiology rather than clinical medicine – or therapeutics- achievements that could be applied immediately to health care. They are in the minority, although they make an interesting set of their own. Among them are prizes for antimicrobial

15 Carlson 2004, 99–108; Mayr 1982, 710–731; Sapp 1990.
16 Kevles and Hood 1992.
17 Judson 1979; Olby 1974.
18 Proctor 1988.
19 Adams 1990; Kevles 1985; McLaren 1990.
20 Coventry and Pickstone 1999.
21 Ferry and Sulston 2002.
22 Yarborough and Sharp 2009.

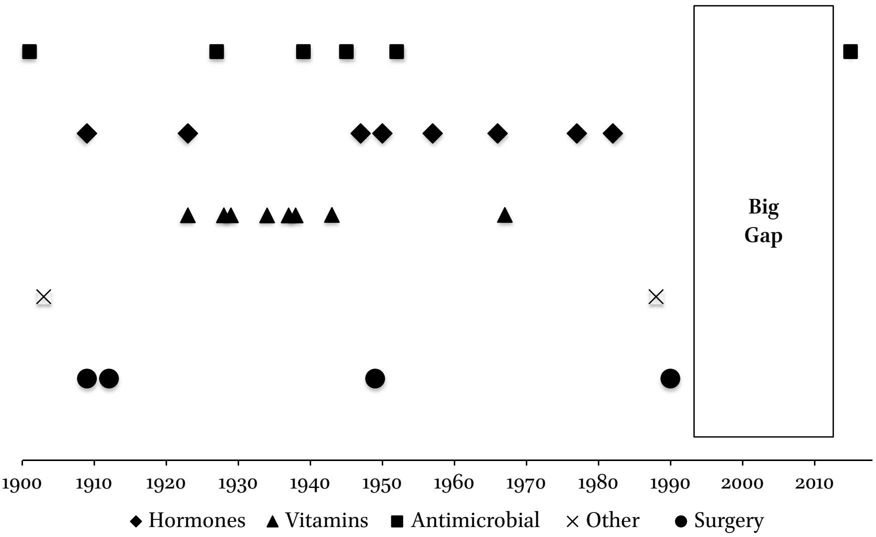

FIGURE 1.7 Nobel Prizes in Physiology or Medicine for Achievements with Therapeutic Applications

drugs – more 'magic bullets' (Figure 1.7).[23] This little cluster is intimately connected to the germ theory paradigm, and when it is combined with Nobel Prizes for hormones – and for vitamins, discussed above, they seem to concentrate at the end of the first half of the twentieth century. Again the 2015 prize stands out almost as an anomaly, to be addressed below.

Surgery is also part of therapeutics. Despite the tremendous prestige afforded surgeons, few have received the Nobel Prize. Theodor Kocher's 1909 prize was for his contributions in thyroid surgery and endocrinology. Three years later, Alexis Carrel was honoured for the techniques of vascular anastomosis and organ grafts. The 1949 award went to Egas Moniz for the now cringe-inducing 'discovery of the therapeutic value of leucotomy [later called lobotomy] in certain psychoses'. Not a surgeon, Moniz was a neurologist, who had promoted the operation.[24]

If all the prizes for therapeutics are gathered together (Figure 1.7) – vitamins, antimicrobials, hormones, drugs and operations – two things appear: that strange outlier of 2015 and a 'big gap' in the recent past. Recent prizes seem to go to physiology rather than therapeutics. In seeking to explain that gap,

23 See Chapter 4 in this volume.
24 See Chapter 6 in this volume.

it is tempting to examine the two therapeutic prizes that immediately preceded its onset. Was there something about the 1988 and 1990 awards that put paid to the competitiveness of future novel therapies? Had all strategies been imagined?

The 1988 prize was a most interesting award honoring three scientists James Black, Gertrude Elion, and George Hitchings. They had used a novel approach to design 'rational derivatives', drugs that would interfere chemically with chemically-defined problems. For example, beta-blockers obstructed internal substances to slow heart rate and lower blood pressure; 6-mercaptopurine interfered with the replication mechanism of cells fooling them into malfunction; allopurinol altered the body's handling of uric acid; cimetidine blocked receptors that triggered stomach acid secretion. Furthermore – like Gerhard Domagk of sulfa fame, all three laureates worked in the private pharmaceutical industry. This prize therefore prompted an appreciation of industrial research in innovation.[25] Using similar concepts during the 'big gap', new rational derivatives were developed to target molecules expressed on tumour cells – the designer drugs – for example, imantinib for leukemia, rituximab for lymphoma, and trastuzumab for breast cancer. None of these brilliant, new entities has yet garnered a Nobel – possibly because the novel *idea* was already lauded back in 1988.

In 1990, surgeon Joseph B. Murray shared the prize with hematologist E. Donnall Thomas for transplantation of kidney and bone marrow, respectively. Like the 1930 award to Landsteiner for blood groups in transfusion – a therapy akin to transplantation – this award was as much for immunology as it was for surgery. Recently surgical innovation trades on the delicate techniques of interventional imaging so that pure surgery begins to shrink and seem obsolete.

Another, possibly better reason for the big gap in therapeutic prizes might be the fact that several earlier prizes in therapeutics – like lobotomy – are among the more embarrassing in Nobel history. Once heralded as triumphs, only to be quickly eclipsed, these awards are especially popular with my seminar students who try to understand how things that seem so wrong now had been laudable not long ago. Did the short-lived reigns of these treatments curb enthusiasm for all therapies in general? Reluctance to recognize treatments may mean that their inventors die before their worth is proven.

25 See Chapter 9 in this volume.

Nobel Errors and Interactions?

Sometimes the awards have been premature: notwithstanding the five Nobels given to understanding, using, and controlling malaria, this treatable, preventable disease still claims half a million lives every year. Meanwhile new infectious diseases have emerged, such as Ebola, AIDS, and SARS. Furthermore, the advent of powerful, new antibiotics has provoked more devastating organisms, such as the Methicillin-resistant Staphylococcus aureus (MRSA).

Study of the – from today's perspective – embarrassing prizes, such as lobotomy, prompts speculation on how seemingly unrelated prizes interact one with another. A tentative example can be found in the greatest outlier of all: the 1973 Prize in Medicine and Physiology given to three scientists Nikolaas Tinbergen, Konrad Lorenz and Karl von Frisch for studies of ethology or animal behavior. Only when two of my students gave back-to-back presentations on 1948 and 1973 did I begin to muse about a possible connection. The 1948 Nobel went to Paul Müller, who had developed the insecticide DDT. Used to control typhus during the war, DDT was also expected to serve the World Health Organization's new project to eradicate malaria. But by 1962, DDT had become a source of environmental degradation, decried in Rachel Carson's influential book, *Silent Spring*. DDT endangered species, and by the early 1970s, it was banned in many countries. Hearing two students describe these Nobels in the same class prompted wondering about the influence of social context in decision-making over the awarding of prizes. Did embarrassment over the DDT prize may have had a subtle, redemptive role to play in the 1973 prize, an environmental apology, a way of 'saying sorry' to the birds and the bees? Are other such external influences to be found?

This surprising connection invites speculation on the strange 2015 prize. It recognized work on diseases and on antimicrobials – both topics that had long been ignored with gaps of their own. It also was the first award to go to a Chinese scientist.[26] The parasitic diseases involved were the ancient scourges of elephantiasis, river blindness, and malaria. The laureates had developed drugs – ivemectin and artemisinin – that had a huge impact in reducing mortality and morbidity from these terrible conditions. The science involved in developing the ivermectin from streptomyces bacteria was an extrapolation upon that already awarded Selman Waksman in 1952. The science involved in developing artemisinin relied on granting credibility to a folk remedy derived from plants. Artemisinin came along just as malarial parasites were beginning to

26 Hua 2016.

develop resistance to the old-standby treatment, chloroquine. The prize surely was motivated by the epidemiological successes. But I wonder if, in resurrecting long-neglected topics – disease and antimicrobials, the Nobel committee was also lauding *access* to treatments and making a statement about research norms endorsed in 1988: the drugs had originated outside of industry and were without active patents in 2015; Merck had been distributing ivermectin for free. Here again, prizes were talking to each other through social and political currents.

What Does it All Mean? Unsung Heroes, Priority Disputes, and Celebration

The Nobel Prizes are of such prominence that much ado is made about non-winners. Students soon discover that worthy scientists are left out of almost every award: unsung heroes – and unsung achievements. For individuals, the frequently nominated, but never honoured include Émile Roux, Casimir Funk, Sigmund Freud, and Oswald Avery. But other worthy people such as Shibasaburo Kitasato, Nicolai Paulescu, and Rosalind Franklin were never nominated for sadly obvious reasons. Similarly, for discoveries rather than people, the Nobel Prize failed to recognize observations that have saved or prolonged many lives, perhaps because their methods relied on established techniques. For example, water purification methods, global eradication of smallpox by the World Health Organization, Papanicoulou and other cytology smears in the early detection of cancer, pulmonary surfactant in the care of premature infants, safe methods of birth control, polio vaccines, fluid treatments for infantile diarrhea. Similarly some influential theories have been ignored – at least so far: evidence-based medicine, psychoanalysis, and psychiatry in general.

Beyond errors, unsung heroes and overlooked or premature achievements are the ugly priority disputes. Albert Schatz, one of Waksman's graduate students felt wrongly excluded from the award and launched a vigorous protest that probably harmed his reputation and Waksman's too.[27] Possibly the most spectacular of these was Raymond V. Damadian's objection to his exclusion in the 2003 prize for magnetic resonance imaging. He purchased full-page advertisements in the *New York Times* to protest the 'shameful wrong'.[28]

The Nobel Prize contributes to the construction of science as a race toward immutable truths and colossal rewards – as if science were a competition and

27 Kingston 2004; Wainwright 1991.

28 Prasad 2007.

discovery a form of archeology, unearthing innovations like potsherds at a dig. This view is held and nurtured by an eager and needy public, expecting new cures and craving immortality. The same view also governs the academic reward system that determines merit by totalling grant funding and enumerating publications in journals of measured influence. Consequently it fosters many kinds of deviance including the aforementioned priority disputes and fraud. But this view does not reflect either the reality of scientific inquiry or the vicissitudes of clinical practice, which are anchored in collaboration, delay, reversal, exceptions, and messiness. False as they may be, competition and the race to truth now define the terrain.

In other words, the prizes can recognize the wrong people and the wrong achievement, and they can generate the wrong message about how science is done. But they are believed.

More than half a century ago, sociologist Robert K. Merton, developed robust theories about scientific discovery, competition, and priority disputes.[29] Citing a 1922 political science paper, he suggested that the vast majority of discoveries are 'multiples' not singletons and they are inevitable. They depend as much (or more) on timing, funding, and intellectual climate as on scientific genius.[30] His insightful essays explain how the norms of science and its reward system generate deviant behavior – the priority disputes and fraud. Web of Science shows that references to Merton in the scientific literature persist and reached more than 700 in 2018.

Intended to be apolitical, the prize is riven with politics and sometimes it spawns interesting, defensive rhetoric.[31] A more pragmatic view of the history of discovery was suggested by Canadian Augustine Brannigan who pointed out that beyond the high-octane realm of historians and philosophers of science, most people are untroubled by erudite reservations over discovery, discoverers, and how science works. Whether or not *scholars* think of discoveries as 'real', the general public well understands the term. Brannigan therefore suggested that credit – priority – rightly belongs to the one who convinces the world, as much, if not more than to the person who made the observation first.[32] If Nobel scientists had not 'convinced the world' before their awards, the Prize certainly completes the job for them afterwards. The awards end up convincing and promoting in a host of other domains, including

29 Merton 1973, 286–324; 352–364.
30 Ogburn and Thomas 1922.
31 Sven Widmalm discusses this topic in Chapter 3 in this volume.
32 Brannigan 1981, 50–62, 70–78.

marketing – of universities, institutes and industry too.[33] In preparing this essay, I stumbled on a whacky example inviting 'internauts' to invent and purchase their own Nobel.[34]

The Need to Create Prizes

The prestige of the Nobel Prize reifies the achievement as a significant 'milestone' of medical 'progress'. It turns laureates into heroes and constructs a scientific 'elite', a pantheon, interconnected and genealogical. Many Nobel achievements are difficult if not impossible to understand for the average person. But the prize lends *unquestioned* prestige and draws public attention. Even if the discoveries are obscure, laureates are venerated with awe. Like Olympic athletes, their productivity is compared one to another;[35] a sperm bank once tried unsuccessfully to immortalize (and capitalize on) their genius.[36]

Much sought after as speakers, laureates find themselves expatiating on topics for which they have no expertise, including philosophy and politics. One of the most influential such works was *What is Life?* (1945) by physics laureate Erwin Schrödinger. Other examples include meditative books by Alexis Carrel, Jacques Monod, François Jacob, Peter Medawar, Roger Sperry, and Eric Kandel. I've often thought it would be fun to run a course on these works; at the least, we need a doctoral dissertation on them. Are the laureates goaded into these writings? Do they accept that the Prize confers a duty to display multi-talented and multi-faceted insights on the state of the world? Their opinions enjoy wide distribution as if they ought to exert value-added influence over those of ordinary mortals. For example, in 1992 an appeal for peace in Croatia was signed by 104 Nobel laureates and printed in the *New York Times*.[37] Surely war will end when Nobel laureates demand it.

Beyond philosophy and prophecy, laureates are venerated like holy saints and martyrs – as if science had replaced religion, to give people something or someone to worship. The book *Science is a Sacred Cow* first appeared in 1950. At the time, its chemist author, Anthony Standen, was complaining about unquestioning dogma that had crept into the techniques of science *educators* – not about science *per se*. It's lead, however, together with my experience

33 See Chapter 9 in this volume.
34 http://krboerup.wixsite.com/yournobelprize (accessed January 10, 2019).
35 Kantha 1995.
36 Plotz 2005.
37 American Initiative for Croatia 1992, A14.

working on science in medical miracles in the Vatican Archives meant that the similarly reverential religious language often applied to the Nobel laureates leaps out. Many world religions, beyond various Christian denominations, venerate once-living saints, prophets, deities, heroes, martyrs, and their wonderous deeds.

Examples of these parallels are easy to find. Marie Curie was a 'martyr' to her science. Many laureates, like saintly heroes, overcome adversity – disease, loneliness, and political oppression. The Oscar-winning film *A Beautiful Mind* is based on the difficult life of economist John Nash. The author of a 2016 article contends that Jews garnered Nobel Prizes because of their struggles against adversity, including the Holocaust, enhancing their ability to achieve; he suggests that their exodus from Nazi Europe brought the balance of intellectual power to America.[38] In a book on *Heroes and Saints*, we find a chapter – not on a laureate – but on Alfred Nobel himself, written in the vein of expiated guilt – guilt over his brother's accidental death, guilt over having given the world a weapon of mass destruction – a protestant saint.[39]

Like John R. Bartlett's biblical proverbs, the aphorisms of Hippocrates, or the sayings of Chairman Mao, the quotations of Nobellists have been gathered for the convenience of speechifying executives, spawning a mini-growth sector in self-published digital books.[40] Again as suggested above, the prizes seem to communicate with each other in heady narratives of redemption and salvation. American George Minot nearly died of severe diabetes first diagnosed 1921 – but he was saved in the nick of time, so the legend goes, by Canadian Fred Branting's discovery of insulin, which rapidly won a Nobel in 1923, so that Minot could go on to win his own Nobel in 1934 for the raw-liver diet cure for pernicious anemia.[41]

More evidence for this connection with religion is to be found in reactions to Nobel laureates whose behavior dishonours the award and themselves. For example, in the 1990s when Alexis Carrel's Nazi sympathies entered political discourse, calls came to rename the streets bearing his name.[42] When D. Carleton Gajdusek was jailed for sexual abuse of children in 1997, his crimes were aggravated by a perceived indignity against the award.[43] Charges of scientific fraud by associates of Nobel laureate David Baltimore attracted enhanced

38 Pratt 2016.

39 Christensen 1997, 85–86.

40 Chityil 2012; Dingle 2012; Pratt 2012.

41 Rogers 2011, 110; Sinclair 2008.

42 Weksler 2004.

43 McCarthy 1997.

media interest.[44] These 'great betrayals' against the sanctity of the Nobel Prize provoke calls for revoking the awards – as if the Nobel prize itself were not a product of human frailty in a given moment.[45]

Sometimes I worry that I might be projecting these connections with religion onto my object of study – because of earlier work; however, I was greatly reassured just two weeks before our Düsseldorf conference, when I received an unsolicited email from Robert Redelmeier, the student who published on the advancing ages of Nobel laureates. I had given a guest lecture about my research on medicine and miracles at his University – and lo and behold, he made the connection all by himself. He wondered if saints might be getting older – just like the Nobel laureates he had studied.[46]

Few people question the sacred entitlement conferred by the prizes. It is the solemnity of this unquestioning practice that is so cleverly satirized in the annual Ig-Nobel awards organized by the magazine *Annals of Improbable Research* and broadcast on American National Public Radio every year since 1991 (Improbable Research).

Yet why should we accept these ancillary determinations? Why does society tolerate, even embrace, the construction of elites and the attendant distortions of scientific practice? Little scholarship addresses why we make prizes at all. Phaleristics – the scholarly study of awards – tends to report in cumulative dictionaries and databases, like encyclopedias of heraldry – documenting the purpose and ranking the prestige and monetary gains. *Critical* phaleristics, so far indulged in mostly by economists and business people, emphasizes secondary gains for the prize creators: elevating their status, motivating workers, bringing social control over winners (happier employees) and political control over the field, raising and skewing its profile.[47] It seems that we have a human 'need' to create heroes, solemnity, and ritual.

In trying to understand the phenomenon of public *acceptance* of prizes beyond the secondary gain for their creators, I have been searching in the literature of psychology, sociology, and philosophy without much success. The closest I can find are studies on 'the human need to compete' – or 'the human need to worship', the former devoted to analysis of war and sport – the latter to studies of religion. Sometimes these 'needs' are viewed as pathological – cravings, 'addictions' – ripe for treatment and elimination. Yet, while the

44 Kevles 1998.

45 Judson 2004, 191–243.

46 Personal communication, Robert J. Redelmeier to J. Duffin, e-mail message, 29 October 2016, with permission.

47 Goode 1978; Chan, Frey, Gallus et al. 2014; Frey and Gallus 2015; Frey and Gallus 2017.

Science Citation Index reveals hundreds of references to Merton each year, few scientific articles (sometimes none!) cite philosophers and sociologists who have written with epistemic justifications and refutations of these needs, the human compulsion to compete, to worship, to venerate: Karl Marx, Émile Durkheim, Max Weber, Jerome Gellman, Pierre Bourdieu.

Perhaps in analogous form both 'needs' (to compete and to worship) are addressed by not the giving, but by the *creation* and the *consumption* of prizes. There is a huge children's literature on bible stories – and we find a bright reflection of the same for science and Nobel laureates – delivering inspiration in narratives of overcoming obstacles and conquering problems. These are optimistic stories for a world that is skeptical of saints and unbelieving in God, and ready for the secular religion of science.

Bibliography

Adams, M.B. 1990. *The Wellborn Science: Eugenics in Germany, France, Brazil, and Russia*. New York: Oxford University Press.

American Initiative for Croatia. 1992. 'An appeal for by 104 Nobel laureates for peace in Croatia'. *New York Times*, 14 January.

Bartos, H. 2015. *Philosophy and Dietetics in the Hippocratic On regimen: a Delicate Balance of Health*. Leiden and Boston: Brill.

Brannigan, A. 1981. *The Social Basis of Scientific Discoveries*. Cambridge: Cambridge University Press.

Burke, P. 2012. *Social History of Knowledge*. Cambridge: Polity.

Carlson, E.A. 2004. *Mendel's Legacy: the Origin of Classical Genetics*. Cold Spring Harbor, NY.: Cold Spring Harbor Laboratory.

Chan, H.F.; Frey, B.S.; Gallus, J. et al. 2014. 'Academic honors and performance'. *Labour Economics* 31: 188–204.

Chityil, G. 2012. *Nobel Quotes: Inspiring and Perplexing Quotes of Nobel Prize Winners*. CreateSpace Independent Publishing Platform.

Christensen, M.L. 1997. *Heroes and Saints: More Stories about People who Made a Difference*. Louisville, KY: Westminster John Knox Press.

Coventry, P.A. and Pickstone, J.V. 1999. 'From what and why did genetics emerge as a medical specialism in the 1970s in the UK?'. *Social Science & Medicine* 49: 1227–1238.

Crawford, E.T. 1984. *The Beginnings of the Nobel Institution: the Science Prizes, 1901–1915*. Cambridge and Paris: Cambridge University Press and Editions de la Maison de l'Homme.

Crawford, E.T. 2002a. *The Nobel Population; A Census of the Nominators and Nominees for the Prizes in Physics and Chemistry, 1901–1950*. Tokyo: Universal Academy Press.

Crawford, E.T. 2002b. *Historical Studies in the Nobel* Archives. Tokyo: Universal Academy Press.

Dingle, C.A. 2012. *Memorable Quotations: Nobel Prize Winners of the Past.* Kindle E-book.

Ferry, G. and Sulston, J. 2002. *The Common Thread: A Story of Science, Politics, Ethics and the Human Genome*. Washington, DC: Joseph Henry Press.

Fleck, L. 1979. *The Genesis and Development of a Scientific Fact*. Chicago: University of Chicago Press.

Frey, B.S. and Gallus, J. 2015. 'Awards, honours, and ribbons: Between fame and shame'. *Vox*, March 11. https://www.bsfrey.ch/articles/D_261_2015.pdf (accessed January 10, 2019).

Frey, B.S. and Gallus, J. 2017. *Honours versus Money: the Economics of Awards.* Oxford: Oxford University Press.

Goode, W.J. 1978. *The Celebration of Heroes: Prestige as a Control System*. Berkeley; Los Angeles; London: University of California Press.

Grmek, M.D. 1981. 'A plea for freeing the history of scientific discoveries from myth'. In *On Scientific Discovery: The Erice Lectures 1977. Boston Studies in the Philosophy and History of Science no. 34*, edited by M.D. Grmek, R.S. Cohen, G. Cimino, 9–42. Dordrecht and Boston: Reidel.

Grmek, M.D. 1999. 'La troisième revolution scientifique'. *Revue médicale de la Suisse romande* 119: 955–959.

Grmek, M.D. 2001. 'Revolutions dans l'histoire de la pensée biomédicale'. In *La vie, les maladies, et l'histoire*, edited by M.D. Grmek and L.L. Lambrichs, 47–49. Paris: Seuil.

Haddad, G.E. 1999. 'Medicine and the culture of commemoration: representing Robert Koch's discovery of the tubercle bacillus'. *Osiris* 14: 118–137.

Howell, J.D. 1995. *Technology in the Hospital: Transforming Patient Care in the Early Twentieth Century*. Baltimore: Johns Hopkins University Press.

Hua, M.J. 2016. *'Magic Bullets from Chinese Herbs. Transcription and the Making of Qinghao History,'* Master's Thesis, Anthropology, University of Chicago.

Improbable Research. 'About the Ig® Nobel Prizes', http://www.improbable.com/ig (accessed January 10, 2019).

Judson, H. 1979. *The Eighth Day of Creation: Makers of the Revolution in Biology*. New York: Simon and Schuster.

Judson, H. 2004. *The Great Betrayal: Fraud in Science*. Orlando: Harcourt.

Kantha, S.S. 1995. 'Is Karl Landsteiner the Einstein of the biomedical sciences?'. *Medical Hypotheses* 44: 254–256.

Keller, E.F. 2000. *The Century of the Gene*. Cambridge, Mass.: Harvard University Press.

Kevles, B. 1999. *Naked to the Bone: Medical Imaging in the Twentieth Century*. New Brunswick, N.J.: Rutgers University Press.

Kevles, D.J. 1985. *In the Name of Eugenics: Genetics and the Uses of Human Heredity*. New York: Knopf.

Kevles, D.J. and Hood, L. 1992. *The Code of Codes; Scientific and Social Issues in the Human Genome Project*. Cambridge, Mass.: Harvard University Press.

Kevles, D.J. 1998. *The Baltimore Case: a Trial of Politics, Science, and Character*. New York and London: Norton.

Kingston, W. 2004. 'Streptomycin, Schatz v. Waksman, and the balance of credit for discovery'. *Journal of the History of Medicine & Allied Sciences* 59: 441–462.

Kuhn, T.S. 1962. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.

Lind, J. 1753. *Treatise on the Scurvy*. Edinburgh: Sands, Murray and Cochran.

Lindahl, B.I. 1992. 'Discovery, theory change, and the Nobel Prize: on the mechanisms of scientific evolution. An introduction'. *Theoretical Medicine* 13: 97–116.

Luttenberger, F. 1996. 'Excellence and chance: the Nobel Prize; case of E. Von Behring and É. Roux'. *History and Philosophy of the Life Sciences* 18: 225–239.

Mayr, E. 1982. *The Growth of Biological Thought; Diversity, Evolution, Inheritance*. Cambridge, Mass.: Belknap Press.

McCarthy, M. 1997. 'Nobel Prize winner Gajdusek admits child abuse'. *Lancet* 349: 623.

McLaren, A. 1990. *Our Own Master Race: Eugenics in Canada, 1885–1945*. Toronto: McClelland and Stewart.

Merton, R.K. 1973. *The Sociology of Science: Theoretical and Empirical Investigations.* Chicago and London: University of Chicago Press.

Nye, M.J. 2006. 'Scientific biography: history of science by another means'. *Isis* 97 (2): 322–329.

Ogburn, W.F. and Thomas, D. 1922. 'Are inventions inevitable?'. *Political Science Quarterly* 37: 83–98.

Olby, R.C. 1974. *The Path to the Double Helix*. Seattle: University of Washington.

Plotz, D. 2005. *The Genius Factory: the Curious History of the Nobel Prize Sperm Bank*. New York: Random House.

Prasad, A. 2007. 'The amorphous anatomy of an invention: the case of magnetic resonance imaging (MRI)'. *Social Studies of Science* 37: 533–560.

Pratt, D. 2016. 'From suffering, adversity to the Nobel Prize'. *San Diego Jewish World*, 29 July. http://www.sdjewishworld.com/2016/07/29/from-suffering-adversity-to-the-nobel-prize (accessed January 10, 2019).

Proctor, R. 1988. *Racial Hygiene: Medicine under the Nazis*. Cambridge, Mass: Harvard University Press.

Redelmeier, R.J. and Naylor C.D. 2016. 'Changes in characteristics and time to recognition of medical scientists awarded a Nobel Prize'. *JAMA* 316 (19): 2043–2044.

Risse, G.B. 1999. *Mending Bodies, Saving Souls: a History of Hospitals*. New York: Oxford.

Rogers, K. 2011. *Medicine and Healers through History*. New York: Britannica Educational Publishing.

Sapp, J. 1990. 'The nine lives of Gregor Mendel'. In *Experimental Inquiries: Historical, Philosophical and Social Studies of Experimentation in Science*, edited by H.E. LeGrand, 137–166. Dordrecht: Kluwer Academic Publishers.

Sinclair, L. 2008. 'Recognizing, understanding and treating pernicious anemia'. *Journal of the Royal Society of Medicine* 101 (5): 262–264.

Stevens, R. 1999. *In Sickness and in Wealth: American Hospitals in the Twentieth Century*. Baltimore: Johns Hopkins University Press.

Söderqvist, T. 2007. *The History and Poetics of Scientific Biography.* Aldershot: Ashgate.

Wainwright, M. 1991. 'Streptomycin: discovery and resultant controversy'. *History and Philosophy of the Life Sciences* 13: 97–124.

Weksler, M.E. 2004. 'Naming Streets for Physicians: "l'affaire Carrel"'. *Perspectives in Biology & Medicine* 47: 67–73.

Wuchty, S.; Jones, B.F.; Uzzi, B. 2007. 'The increasing dominance of teams in the production of knowledge'. *Science* 316: 1036–1039.

Yarborough, M. and Sharp, R.R. 2009. 'Public trust and research a decade later: What have we learned since Jesse Gelsinger's death?'. *Molecular Genetics and Metabolism* 97 (1): 4–5.

YourNobelPrize, http://krboerup.wixsite.com/yournobelprize (accessed January 10, 2019)

Zuckerman, H. 1967. 'Nobel laureates in science: patterns of productivity, collaboration, and authorship'. *American Sociological Review* 32: 391–403.

Zuckerman, H. 1978. 'The sociology of the Nobel Prize: further notes and queries'. *American Scientist* 66: 420–425.

Zuckerman, H. 1992. 'The proliferation of prizes: Nobel complements and Nobel surrogates in the reward system of science'. *Theoretical Medicine* 13: 217–231.

Zuckerman, H. 1996. *Scientific Elite: Nobel Laureates in the United States*. New Brunswick, N.J.: Transaction Publishers.

Zwart, H. 2008. 'Understanding the Human Genome Project: a biographical approach'. *New Genetics and Society* 27 (4): 353–376.