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Roslynn D Haynes

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pus.sagepub.com**Roslynn D Haynes**

University of New South Wales, Australia; University of Tasmania, Australia

Abstract

The cluster of myths relating to the pursuit of knowledge has perpetuated the archetype of the alchemist/scientist as sinister, dangerous, possibly mad and threatening to society's values. Shelley's *Frankenstein* provided imagery and a vocabulary universally invoked in relation to scientific discoveries and technological innovation. The reasons for the longevity of this seemingly antiquated, semiotic imagery are discussed. In the twenty-first century, this stereotype has been radically revised, even overturned. Scientists are now rarely objects of fear or mockery. Mathematicians, both real-life and fictional, are discussed here as being representative of scientists now depicted empathically. This article examines possible sociological reasons for this reversal; what the revisionist image suggests about society's changed attitudes to science; and what might be the substitute fears and sources of horror.

Keywords

alchemist, communication, environment, evil scientists, Frankenstein, 'mad scientist', mathematicians in fiction, myth, semiotic characters

Introduction

Myths are the signature of cultures. They express in enduring form the hopes, fears, values, transgressions and punishments that underpin the social fabric. In British, French and German literature especially, the cluster of myths relating to the pursuit of knowledge has perpetuated the archetype of the alchemist, and his descendant the scientist, as sinister, dangerous, possibly mad and threatening to society's values, even to human survival.

The pursuit of forbidden knowledge and consequent punishment have been deeply embedded in the human psyche since ancient times, as expressed in the mythological narratives of Eden, Prometheus, Daedalus and Icarus and Pandora's box. All represent an hubristic desire for power of knowledge in some form and a challenge to authority, followed by retribution that may affect not only the protagonist but, as in the Genesis story and Pandora's box, humanity in general.

Corresponding author:

Roslynn D Haynes, School of Humanities, University of Tasmania, 5 Ellington Road, Sandy Bay, TAS 7005, Australia.

Email: R.Haynes@unsw.edu.au; roslynn.haynes@utas.edu.au

Like these archetypal myths, narratives depicting scientists as obsessive seekers after knowledge have emphasized the reversal of expectation and the disaster of success due to the scientist's failure to foresee the consequences attendant on achieving his goal. The alluring promises conceal vast destruction, sometimes because they are not achieved and a life is wasted in the quest, as in Balzac's (1834) *La Recherche de l'Absolu*, but more often when the search *is* successful. The tragedy of Frankenstein begins at the exact moment of his experimental success, when the Creature comes to life:

I saw the dull yellow eye of the creature open; it breathed hard and a convulsive motion agitated its limbs.

How can I describe my emotions at this catastrophe? ... now that I had finished, the beauty of the dream vanished, and a breathless horror and disgust filled my heart. (Shelley, 1996 [1818]: 34)

Frankenstein's many progeny in fiction and film¹ include a cavalcade of mad, evil doctors of science from Dr Jekyll and Dr Moreau to Dr Strangelove and Dr Wilde² who are perpetrators of horror. Clerens rated the 1931 Universal classic film *Frankenstein*, which introduced Boris Karloff as the Monster, as 'the most famous horror movie of all time' (Clerens, 1967: 64) and, after surveying over a thousand horror films from 1931 to 1984, Tudor concluded that one-third of these involved 'mad' scientists or their creations as villains or monsters, while scientists were heroes in only 11% of such films (Tudor, 1989a, 1989b). More recently Weingart et al. (2003) analysed 222 movies and concluded that even initially 'good' scientists were often manipulated by powerful, evil interests or corrupted through ambition.

Why has a society, which is so dependent on its scientists for infrastructure, wealth and lifestyle, for medical breakthroughs and repair of environmental damage, and which provides vast sums of money for scientific research, continued to condemn them in its most popular modes of entertainment as harbingers of horror and terror? Why has it perpetuated stereotypes so outmoded and so implausible, almost parodic?

The semiotic 'mad' scientist

The first point to note is that there is nothing personal in this vilification. The mad, evil scientist is almost invariably a semiotic figure. He (the gender specificity is factual) is rarely intended to refer to any particular scientist, or even to appear realistic. Rather he represents a rejection by what we might call the 'colonized' view of science. Just as imperial history was written by the colonizers, but as we now recognize, the colonized retaliated in unofficial, oral histories and satirical stories mocking their conquerors, so the 'official' histories of science, from Sprat's (1667) *The History of the Royal Society* to biographies of contemporary scientists, celebrate the discoveries of great scientists, the successful experiments, the beneficial results. However, from the mid-twentieth century, there has also been criticism by historians of science and sociologists of the image of the noble, objective, open-minded scientist, intent only on seeking truth. In the 1960s, Thomas Kuhn and Michael Polyani drew attention to flaws in the validity of what Kuhn called the 'image of the scientist as the uncommitted searcher after truth ... the explorer of nature – the man who rejects prejudice at the door of his laboratory' (Kuhn, 1963: 347), pointing instead to the role of the scientists' subjective experiences and motives in proposing and clinging to particular paradigms that might later be overthrown. This was reinforced by Bernard Barber's analysis of science and social structures (Barber, 1952) and Mahoney's analysis of the characteristics of scientists as a profession (Mahoney, 1976: 3–14). But long before the studies of Kuhn and Polyani, there had been a rich counter-culture produced by non-scientists, who refused to accept the grand narrative of the noble

scientist. In this unofficial record, caricature and vilification were the foremost methods of subversively ‘answering back’ to the hegemonic power of the scientific establishment.

This rejection of scientific authority is closely associated with, and perhaps springs from, a deep-seated fear of a power that cannot be gained or overthrown by force of arms, religious edict or other traditional means of achieving supremacy. From Haynes’ study of scientist characters in fiction, and later film, from medieval times to the end of the twentieth century, it was apparent that the two most prevalent stereotypes of the scientist, the foolish scientist-inventor and the obsessive, usually dangerous, alchemist figure, exemplified these two modes of subversion – caricature and vilification (Haynes 1994, 2003). The former represents the attempt to curtail fears about scientists by mocking their experiments as trivial or unsuccessful. From Chaucer’s hapless alchemist,³ the gullible virtuosi of the Restoration stage, oblivious to the world around them⁴ and Swift’s Projectors of Laputa⁵ to the comic, absent-minded professors of twentieth-century cinema, this caricature has been consistently popular. The latter image of the obsessive, evil and dangerous scientist, which owed much to the reputation of the alchemists, embodies society’s fears concerning arcane knowledge that also carries alluring promises.

With the advent of cinema, these two stereotypes became both more exaggerated and more entrenched. The earliest examples of film already demonstrate this preoccupation. Georges Méliès adapted the Faust legend for *Le Cabinet de Méphistophélès* (1897) and *Damnation de Faust* and *Faust et Marguerite* (1898). He also photographed pantomime clips of ‘ludicrous expeditions’, showing foolish inventors, astronomers and alchemists from the ‘Institute of Incoherent Geography’, and in 1902 produced the satirical *Le Voyage dans la lune*, drawing on Verne and Wells.⁶ In American cinema, also, foolish inventors and evil scientists featured prominently from its inception. In 1910, the Edison Studios released both the comic, ‘mad-professor’ film, *A Trip to Mars* and the first film version of *Frankenstein*. The latter begins with the heavily underlined moral warning that ‘it is the story of Frankenstein, a man of science who sought to create a man after his own image without reckoning upon God’, thereby importing into Shelley’s entirely secular and unredeemed scenario elements of supernatural order and divine justice consistent with the myths cited above.

From *The Absent-Minded Professor* (1961) to certain episodes of the *Dr. Who* series, scientists *qua* inventors continued to be cast as comic maniacs, who mock the concept of the scientist as superior to ordinary people. Although not intentionally evil, they were not harmless, and their inventions were temporarily disastrous. In *Honey I shrunk the Kids*, Wayne Szalinski’s (1989) electromagnetic ray reduced children to a ½ cm in height, and Dr Emmett (‘Doc’) Brown (1985) of *Back to the Future* eventually admitted to regretting that his time-machine has altered history and ‘caused nothing but disaster’. Their failures expressed society’s *Schadenfreude*, the small triumph of the disempowered over the powerful.

More often, however, the prototypical scientist of counter-culture exemplified intellectual *hubris*. Arrogant, secretive and dangerous, his obsessive focus on his research rendered him contemptuous, even oblivious, of society’s norms and relationships. The master narrative of the mad scientist consistently presented him as a dangerous over-reacher, determined to transcend human limitations and precipitating a wave of retributive events. This character was pivotal in subverting the ‘great men’ account of science, enacting instead our nightmares that new, secret knowledge may misfire or be deliberately misused. He was depicted as mad, partly because he was not amenable to reasoned discourse, but also because, from Roman times, genius was linked with insanity as symptomatic of an unbalanced nervous system.⁷

However, if the narrative of the mad, bad scientist was essentially a myth concerning arrogance and power, it is reasonable to enquire why such traits were so consistently attributed to scientists rather than to more obvious agents of power – dictators, generals, heads of corporations, media barons or terrorists.

A key reason was the longevity of this character. Frankenstein and his numerous literary descendants had as their common ancestor the medieval alchemist, who continued to provide the format, the imagined physical appearance, the alleged character traits and much of the scenario for narratives of the mad, evil scientist. Scientists were all too readily slotted into this mould.

Alchemist ancestors

A major factor in the continuing appeal of the alchemist narrative was its ability to evoke perennially convincing patterns of horror, mystery and evil, along with the allure of its promises. Significantly, modern counterparts of the goals of alchemy, perpetual motion, transmutation of base metals to gold, an elixir of youth and creation of an homunculus, continue to preoccupy us, even while the potential of some (human cloning, for example) make us wary. Fear and horror also continue to fascinate us. Even though most of the examples from past centuries with their focus on graveyards and charnel houses, corpses, ghosts and monsters may have ceased to frighten us, many elements of the Frankenstein narrative remained perpetually relevant as symbols of changing technology, if not of that technology itself. Films intensified this immediacy, reaching out to a far wider audience than the written word with special effects that rendered plausible the most bizarre scenarios of alien invasions, monsters revived from the past or engineered in the future or end-of-the-world cataclysms. In most cases, scientists were implicated in precipitating these events since only they were perceived as having the knowledge to do so. Turney has explored this inherent suspicion of science, particularly in the biological sciences (Turney, 1998).

The endurance of the alchemist figure

Because the alchemist stereotype personified unconscious fears of whatever was new, powerful and beyond our control, its association with virtually any new development in research was thus perennially relevant (Haynes, 2006). In particular, the Frankenstein story, which, like the Creature, has acquired a life independent of its creator, has been continually recast and updated to retain applicability to any scientific project that nudges the barriers of knowledge, violates social conventions, is morally sensitive or potentially dangerous. Wells' (1896) novel *The Island of Doctor Moreau* and the film versions that employ contemporary biotechnology,⁸ the two films of *The Fly* (1958 and 1986); John W. Campbell's (1938 [1948]) novella *Who Goes There?*, which inspired two film versions titled *The Thing* (1982 and 2011); *The Quatermass Experiment* (TV series, 1953, film 1955, TV movie, 2005); the British TV series *A for Andromeda* (1961) and the subsequent TV movie (2006) and the similar scenarios of the films *Species* (1995), *Species II* (1998) and *Splice* (2009) form a short list of the very large number of novels and films depicting scientists so obsessed with pursuing their research and oblivious to likely consequences, that they unleash continuing and widespread disaster.

Like their alchemical prototypes, real-life scientists have been perceived as secretive, obfuscatory, unable to communicate outside their discipline, having different allegiances from other people, suppressing human affections and ruthless in their idealism, prepared to sacrifice humans, animals and safety in their reckless pursuit of knowledge. At times, as in the case of the Manhattan Project, scientists have seemed to confirm this careless immorality,⁹ and this was perpetuated in a series of films both documentary (*The Day After Trinity*, 1980 and *The Shadow Makers*, 1989) and fictional, epitomized in the cult film *Dr. Strangelove: Or how I Learned to Stop Worrying and Love the Bomb* (1964). Geneticists have been portrayed as violating the most entrenched of cultural norms associated with the sanctity of human life. Radiation-driven mutations (typified by Godzilla but including dozens of other monsters), eugenics (*Gattaca*, 1997) and cloning (*The Boys from*

Brazil, novel by Levin in 1976, film 1978 and *Jurassic Park*, novel 1992, film 1993) are routinely presented as the definitive goals or collateral damage of geneticists' experiments.

Ultimately, the perennial fascination of the master narrative based on the alchemist is that it tells a story of what we both desire and fear to know – the story of power beyond our dreams but also beyond our control. Despite our control over the material world, we are still confronted with unforeseen disasters – pandemics, terrorist attacks, atomic power disasters and tsunamis. Hence, we have clung to stories that offered some rationale for our uncertain existence by embedding it in the unfolding legend of the powerful mage, the sinister alchemist, the obsessive scientist.

At base level, this story draws strength from the intrinsic appeal of horror. Horror fiction and horror movies allow us to indulge our worst impulses and fears, to be, at least vicariously, complicit in what violates culturally sanctioned norms of 'decency', while eventually seeing the powerful one dragged down (and in fiction and film he almost invariably is), the threat averted and natural order restored. Writer Stephen King (1983) asserts that the effect of horror fiction is ultimately reactionary, because we see that the alternative is too terrible and hasten back to the 'real world' with a sense of relief:

We love and need the concept of monstrosity because it is a reaffirmation of the order we all crave as human beings ... After all, when we discuss monstrosity, we are expressing our faith and belief in the norm and watching for the mutant. The writer of horror fiction is neither more nor less than an agent of the *status quo*. (p. 30)

A new image of scientists

Yet, in the first decade of this century, even sporadically in the 1990s, this entrenched stereotype of the mad, bad scientist has been progressively eroded. A significant number of novels and films have now appeared in which scientist characters are no longer merely semiotic indicators of fearful threats, but modelled on ordinary people whose science intersects with their other human concerns – family, friendships, love, loss, grief and leisure.

The sociological reasons for the demise of the mad, bad stereotype are as complex as the reasons for the longevity of the alchemist figure. All reflect decreasing ignorance and fear of science and increasing acceptance of scientists as professional members of society, contributing to an optimistic future for the planet.

Familiarity

Scientists are no longer burdened with the reputation of obscurity and secrecy. Largely because of television, we are more familiar with actual scientists than any previous generation. We should never underestimate the impact of a charismatic presenter of a science documentary, especially one focusing on Nature. David Attenborough's multiple British Broadcasting Corporation (BBC) series on biology, geologist Iain Stewart's (2007) *Earth* series, theoretical physicist Jim Al-Khalili's (2010) *Chemistry*, primatologist Jane Goodall's documentaries about her work with chimpanzees (1984–2011), Richard Smith's (2012) *Australia: The Time Traveller's Guide* and particle physicist Brian Cox's astronomy series¹⁰ as well as the Nature programmes on the National Geographic and Discovery channels show us scientists who are neither threatening nor secretive, but infectiously curious about our world, communicating what we want to know in language we understand. They substitute for the stereotype of the arcane, threatening scientist an image of healthy, attractive, outdoors adventurers, generous with their knowledge and respectful of the organisms and processes they explain to their audiences. Similarly laboratories, as shown on television, are no longer

secret, threatening places with dangerous-looking, unfamiliar equipment, but light and bright and staffed by equal numbers of men and women, most young and enthusiastic.

Education and Communication

Given the resources of the Internet, we are now able to educate ourselves about scientific research, especially in medical science, and to be aware of its implications. Armed, through *Google*, with reviews and journal articles at whatever level we choose, we no longer feel inferior in scientific matters but, rather, empowered to form our own opinions, to make decisions, even to protest against research of which we may disapprove.

Lab Lit

Over the last two decades, scientists have recognized the pragmatic need to be better communicators in order to improve their public image and thereby access funding. From Verne and Wells to Fred Hoyle, Isaac Asimov, Arthur C. Clarke, Carl Sagan and Gregory Benford, some of the best science fiction authors were trained in a branch of science, and early in the twentieth century, a small number of novels focused on scientists as characters,¹¹ but more recently there has been a significant volume of mainstream fiction, as distinct from science fiction, about working scientists engaging with the ethical issues arising from their research.

Ian McEwan, a prize-winning mainstream writer, has written two novels with a scientist as the main character. Not himself a scientist, McEwan (2005) shadowed a neurosurgeon for 2 years to gain an accurate insight into the life of his protagonist in *Saturday*. Henry Perowne, a neurosurgeon, prepares to enjoy a day off from operating by playing squash, shopping, cooking a meal and fielding longstanding family tensions between his daughter and father-in-law. As unexpected as the burning plane he sees plummeting from the sky is the attack on his person by a belligerent stranger after a minor car collision. Yet, his intrinsic medical knowledge immediately leads him to diagnose his assailant's behaviour as symptomatic of the early stages of Huntingdon's Disease, and he later persuades the man to have treatment for his condition. In this highly sympathetic portrait, McEwan explores the subtle interaction between Perowne's scientific rationalism, his compassion, his deep emotional relationship with his wife and adult children, his sense of his privileged social position and his ambivalence about political protests, war and terrorism. By contrast, Michael Beard the protagonist of McEwan's (2010) later novel *Solar* is an extremely unsympathetic scientist, a Nobel laureate physicist now well past his prime, who plagiarizes the results of a junior colleague and accidentally kills him. Beard can be seen as both a caricature from a black comedy and a sinister figure, trading on the authority of his past reputation.

Both these novels are essentially about scientists in isolation. On the other hand, authors of what Jennifer Rohn has designated 'Lab-lit' (Rohn, 2010b) are concerned to engage with the process of 'doing science' and to indicate realistically how actual scientists think and behave in the intense atmosphere of a research laboratory. Rohn (2009, 2010a), herself a cell biologist, has produced two such novels, *Experimental Heart* (2009) and *The Honest Look* (2010), which explore the lives of young researchers caught up in the pressures to produce ground-breaking, 'celebrity' research into cancer or Alzheimer's Disease, competitive institute politics and ethical issues related to less-than-meticulous experiments and vested interests of pharmaceutical companies, as well as the emotional relationships tested daily in the hothouse of a working laboratory. There are no evil scientists here, only tentative, often insecure post-docs intent on pursuing their careers. Allegra Goodman's (2006) *Intuition* has a similar setting, a privately owned, struggling research institute, which becomes polarized when a researcher is accused by a colleague of fudging, or at least selecting, his results

to support claims of a cure for cancer. The scientists are portrayed as being so dedicated to achieving their goal, for idealistic as well as personal reasons, that they are easily prey to self-delusion.

Another group of novels about fictional scientists expands the setting outside the laboratory to include field-work and social and environmental issues. The characters suffer for their research, sometimes through physical danger, sometimes through personal anguish. The protagonist of Susan Gaines' (2001) *Carbon Dreams* is a female oceanographer, South American by birth. At the prestigious, male-dominated Scripps Institute in California, where Gaines also worked, she is made to feel an outsider, struggling to gain research funding, encountering difficult ethical choices relating to climate change and having to choose between her lover and career opportunity. In William Boyd's (1990) *Brazzaville Beach* Hope Clearwater, a biologist studying chimpanzees in Africa, has attempts made on her life when her observations run counter to those of the director of the project. The theme of the younger scientist threatened by a senior colleague recurs in Sara Gruen's (2010) *Ape House*, when a young female scientist at the Great Ape Language Lab is determined to save her family of apes from commercial exploitation and trauma. In Amitav Ghosh's (2004) *The Hungry Tide*, a young marine biologist is drawn into political turmoil in her environmental crusade to save river dolphins in the labyrinthine Sundarbans of the Bay of Bengal. In Pippa Goldschmidt's *The Falling Sky* (2013), a young woman astronomer makes an observation that appears to challenge the established cosmological paradigm of the Big Bang. Instead of being an acclaimed breakthrough, the collegial jealousy it arouses increases the personal trauma she has carried from childhood when her sister drowned.

The diversity of setting and research areas in even this small selection of recent novels about scientists indicates the marked change from the stereotypical mad, evil scientist or the foolish inventor. These scientists are credible, modern people working in the real world, engaging with issues in science, society and relationships. Although, according to the most recent list (Lab Lit List, 2013), there are less than 100 such novels, the number is increasing annually.

Apart from novels with a modern setting there has been increasing interest in exploring the human turmoil of historical figures in science as subjects for novels. While some of these characters may seem to revert to the stereotype of the inhuman, obsessive scientist, unable to form enduring relationships, they are depicted with a new level of understanding and empathy.

The French Mathematician by Tom Petsinis (1997) traces the life of the nineteenth-century mathematical prodigy Évariste Galois who, at age twenty-one while still at high school, devised new theories of polynomial equations, and at his death left three papers of far-reaching significance on Galois Theory and finite (Galois) fields. Galois is portrayed as obsessive about mathematics and, through his adoration of Pythagoras, monastic in his dedication to pure mathematics. He is arrogantly dismissive of his peers, family and teachers, rejecting politics, friendships and romance. Yet, after his father's death, he passionately embraces Romanticism and the French republican cause, readjusting his view of mathematics from a temple of classical austerity to a power arising 'from the furnace of revolution ... engendered on the streets' (p. 210). Despite his unattractive arrogance, we retain sympathy for Galois because of his integrity, dedication and conviction that he is serving a greater good – at first mathematics, then the Revolution.

Clare Dudman's (2003) *Wegener's Jigsaw*, a meticulously researched, fictional biography of Alfred Wegener, polar explorer, geophysicist and meteorologist, is characterized by variety and eloquence. Dudman was clearly fascinated by the historical figure of Wegener, who first proposed the theory of plate tectonics and continental drift. She traces his life, employing the immediacy of first person, present tense narrative, from his Berlin childhood, through his struggles to gain a footing in the academic world, his pioneering balloon flights to measure atmospheric pressure, his marriage and love for his daughter, his conscription into the army and his expeditions to Greenland, on the last of which he died in the frozen tundra. This life full of physical action would easily retain

our interest without reference to intellectual struggles, but Dudman is committed to recreating the whole Wegener, including the poetic voice adapted from his journals, a language rich in poetry and symbolism, especially the descriptions of ice in its many forms, colours, textures and significance.

Daniel Kehlmann's (2005) novel *Measuring the World* (film 2012) counterpoints two towering figures in nineteenth-century science, mathematician and astronomer Carl Friedrich Gauss and the geographer Alexander von Humboldt. The aristocratic, dictatorial but immensely energetic von Humboldt compulsively measures every feature he encounters travelling through jungles and over snow-covered mountains in Central and South America. Gauss, by contrast, is an irascible recluse, who hates travelling yet, without leaving home, proves that space is curved. Kehlmann's two scientific geniuses are compromised as human beings by their arrogance, their contempt for others and their lack of interest in normal human interactions, yet they are portrayed as fascinating individuals whose idiosyncrasies accent their intellect and make them credible personalities.

Tracy Chevalier's (2009) *Remarkable Creatures* traces the life of the little-known Mary Anning, a nineteenth-century English fossil-collector and palaeontologist, who made important discoveries in the marine fossil beds at Lyme Regis in Dorset, including ichthyosaur, plesiosaur and pterosaur skeletons, and contributing to revolutionary ideas about the prehistory of Britain.

The bi-centenary of Charles Darwin's birth and sesquicentenary of the publication of *The Origin of Species* elicited a crop of biographies, novels, docudramas (*Darwin's Lost Paradise*, 2009; *The Voyage that Shook the World*, 2009; *Darwin's Brave New World*, 2009) and films (*Creation*, 2009; *Darwin's Dangerous Idea*, 2009). Like most such celebrations, it had a further, unstated agenda, being conducted with a sense of urgency, even missionary zeal, to combat the revival of Creationism. In all these biographical treatments, the focus is on the young, adventurous Darwin of the *Beagle*, riding, collecting, diving and filled with wonder and enthusiasm, rather than the chronically ill, older man painstakingly collecting data, who had dominated earlier presentations. In David Attenborough's (2009) documentary *Charles Darwin and the Tree of Life*, Darwin is transformed from a mere observer of extinctions into an environmental warrior combating extinction.

Mathematicians in fiction and film

Since the 1990s, there has been an increasing number of fictionalized biographies and novels exploring the complex inner and outer lives of mathematicians. Formerly, mathematicians, insofar as they had been subjects in fiction at all, had been stereotyped as emotionally deficient (Rankine, 1874) or escapist, avoiding emotional relationships because they lacked mathematical clarity and precision (Frisch, 1969 [1953]). But following the publicity given to the solution by British mathematician Andrew Wiles in 1993 of Fermat's Last Theorem, there has been wider interest in mathematicians, even though their discipline, which 'speaks' a different language and has few external indicators, presents problems for a general audience. To overcome this difficulty, writers and filmmakers have selected subjects who embody some dramatic interest apart from mathematics – unusual outward circumstances, a mental condition or personality disorders. Yet, all these figures are presented with sympathetic understanding rather than satirical judgment.

The most unlikely mathematical partnership recorded was that between the eminent Cambridge professor G.H. Hardy and self-taught Indian genius Srinivasa Ramanujan, a shipping clerk from Madras, who, in January 1913, sent Hardy a 10-page letter outlining his theories on prime numbers and infinity. Initially disposed to consider the writer a crank, Hardy was soon amazed at the intellectual leaps, albeit without connecting proofs, which he nevertheless found to be verifiable. Intrigued, he invited Ramanujan to Cambridge and the two collaborated for nearly 5 years before Ramanujan, ill from malnutrition and a suspected liver infection, returned to India, where he died

shortly afterwards. Although united by their passion for mathematics, the two men were opposites in cultural background, religious belief (Hardy was an atheist and rationalist, Ramanujan a devout Brahmin, who believed that formulae were transmitted to him in prayer) and in their approach to mathematics. Ramanujan arrived at solutions intuitively, while Hardy was rigorous in expounding the rationale for a conclusion. Hardy provided the proofs for Ramanujan's theorems about primes and theta function, prompting a vast body of subsequent research. In this century, novelists and particularly playwrights have been drawn to the relationship between these two men, concentrating on the unique aspects of their lives rather than their mathematical discoveries, which are not easily conveyed to non-mathematicians.

David Leavitt's (2007) meticulously researched novel *The Indian Clerk* contrasts the psychological depths of the two men, the opposite worlds they have come from and the pressures that interrupt their passion for mathematics. Playwrights attracted to this mathematical partnership have devised various external, visual correlatives for an essentially intellectual process. Ira Hauptman's (2003) play *Partition* introduces Eastern mysticism through the character Namagiri, the personal deity of Ramanujan in India, to depict his inspired solutions. Ramanujan insists that the goddess literally writes equations on his tongue with her finger, a claim that confounds Hardy; yet, he himself wrote of the art and beauty of mathematics, comparing it to painting and poetry (Hardy, 2004 [1940]). Simon McBurney's (2007) play *A Disappearing Number* suggests interconnections between mathematics, love, time and infinity by juxtaposing the Hardy–Ramanujan story with a contemporary narrative of a female maths professor so fascinated by Ramanujan that she retraces his steps to India and, like him, dies there. Her non-mathematical partner, who strained to understand her lectures about infinity, now struggles to cope with her death. David Freeman's (2006) play *A First Class Man* (now also a film) also focuses on Ramanujan, incorporating a simplified form of Ramanujan's work on partition theory and relying on analogy to indicate the beauty and complexity of mathematics. Although portrayed as the 'Other' in all these treatments, Ramanujan is invariably presented as dignified, secure in himself and his beliefs, and never mocked. Rather his honest questions and answers overturn the conventional assumptions of his British hosts.

By contrast, Sylvia Nasar's (1998) *A Beautiful Mind* (film 2001) maintains audience interest by emphasizing the eccentric behaviour of economist/mathematician John Forbes Nash, Jr. His ground-breaking work on game theory, partial differential equations and the Nash equilibrium led to diverse applications in market economics,¹² computing, artificial intelligence and military theory, but Nasar focuses on his paranoid schizophrenia, his anti-social personality, his egotism and delusions about Soviet conspiracies against him. In clinical terms, Nash is, indeed, a mad scientist, with many of the traditional characteristics of the alchemist – physical isolation, xenophobia, inability to communicate, absorption in his private world of codes and formulae. Yet, he is presented with understanding and sympathy through the technique of keeping the audience unsure about what is actual, and what exists only in Nash's mind, so that we are persuaded to consider with compassion the problems attendant on intellectual genius.

The British mathematician Alan Turing, one of the designers of the electro-mechanical computer Bombe that was developed to break the Enigma code used by the Germans during World War II, has also attracted biographers, novelists and film-makers. Again it is his tortured personal life rather than his mathematical genius that has generated interest in the person. In 1952, Turing was convicted of homosexuality, when this was a criminal offence in Britain; he lost his security clearance and took his own life 2 years later. The earliest attempt to engage sympathetically with this controversial figure was Andrew Hodges' (1983) acclaimed scientific biography *Alan Turing: The Enigma*. Hodges relates Turing's essential honesty and integrity to his mathematical reasoning and idealism. A later biography by David Leavitt (2006), *The Man Who Knew Too Much: Alan Turing*

and the *Invention of the Computer*, speculates about links between Turing's mathematical genius and his social ineptitude, literal-mindedness, his compulsive honesty and his fascination with machines.

Turing also championed the idea of artificial intelligence when this was a controversial idea. In 1936, he designed the Turing machine to model the human mind and developed the Turing Test for human-level intelligence in a computer. John L. Casti's (1998) *The Cambridge Quintet: A Work of Scientific Speculation* recreates an imaginary presentation of this radical idea to a group of partly intrigued, partly resistant Cambridge dons at a dinner party hosted by C.P. Snow. Their objections provide the opportunity for Turing to explain his conceptual model in non-mathematical terms, appropriate to readers.

Hugh Whitemore and Andrew Hodges' (1986) play *Breaking the Code* (TV film 1996), with all the double meaning implicit in its title, highlights the tragic disparity between Turing's intellectual stature and his sexual needs. Very different again is Christos Papadimitriou's (2003) *Turing: A Novel about Computation*, a fantasy in which 'Turing' is an artificially intelligent computer program with the personality and memories of Alan Turing. So far from avoiding mathematical content, this novel, written by a computer science professor at Berkeley, is heavily freighted with lectures on proof, Euler's work and paradox, all supposedly made palatable by a love story.

Turing continues to attract writers and audiences. Janna Levin's (2006) *A Madman Dreams of Turing Machines* offers a poetic account of Alan Turing and Kurt Gödel, and there is even an opera by Julian Wagstaff (2007), *The Turing Test*, witty, romantic, tragic and, of course, intelligent. Of these diverse studies, only Casti's focuses on Turing as a committed scientist arguing passionately for his ideas. The others, in various ways, emphasize the personality of the man, who was both exploited by the British government for his talents and 'Othered' for his sexual preferences, while the mathematics, which gave his life meaning, is glossed over.

The uncertainty surrounding both intelligence and madness has also been explored in fictional characters. In David Auburn's (2000) play *Proof* (film 2005), a gifted but mentally unstable mathematician Robert dies and the proof of a paradigm-changing theorem on prime numbers is discovered in his notebooks. Robert's daughter Catherine claims that she, not her father, who was already suffering from dementia, had written the proof. Handwriting evidence is inconclusive and when her sister suggests that Catherine is mentally unsound, she begins to fear she may have inherited her father's mental illness as well as his mathematical brilliance. The play concludes with the suggestion that Catherine, though psychologically fragile, was indeed the author of the proof, but there is no definitive proof of this.

In Filibert Schogt's (2000) novel *The Wild Numbers*, another fictional mathematician Isaac Swift, a hitherto mediocre professor at an undistinguished university, believes he has solved the (imaginary) Beaugard's Wild Number Problem. Unlike the previous authors, Schogt is a mathematician and understands that Swift's obsession with maths comes at a cost: a broken relationship, social ineptitude and ostracism, grave self-doubts, an accusation of plagiarism that leads to violence and the emotional roller-coaster of a major mathematical 'discovery' which proves to be incorrect. Although the character of Swift verges on caricature, the novel is a richly human and sympathetic story about the struggles of a pure mathematician.

Apostolos Doxiadis' (2000) *Uncle Petros and Goldbach's Conjecture* also traces the frustration of a pure mathematician determined to solve the most difficult of problems. Petros Papachristos is driven by a passion to understand the reasoning underlying Goldbach's famous but unproved Conjecture, that every even integer greater than 2 can be expressed as the sum of two prime numbers. Several real-life mathematicians appear in the novel, including Hardy, Ramanujan and Gödel. Both this and Schogt's novel present mathematics as an enthralling, creative adventure of the mind, irresistible to the mathematician engaged with a particular problem.

Rebecca Goldstein's (2005) *Incompleteness: The Proof and the Paradox* explores the mathematical world of Kurt Gödel and his theorem of incompleteness, which asserts that in every system of arithmetic, there are true statements that cannot be proved. Goldstein traces the manipulation of the theorem by positivists and postmodernists, with whom Gödel and his friend Albert Einstein vehemently disagreed. Far from posing a threat to society, these mathematicians appear as vulnerable, often self-tortured individuals, victims of manipulation by others but overall maintaining their integrity.

Breaking taboos

Western society is now much more accepting of formerly taboo-breaking discoveries and inventions and hence of the scientists who propose them. We can compare the resistance to the contraceptive pill in the early 1960s with the relatively rapid acceptance of genetic selection of embryos since the 1990s. New reproductive technologies initially evoke misgivings, but the opposition is soon demolished by accounts of happy families benefiting from them. Artificial insemination, embryo transfer, surrogacy, selection against embryos with incurable genetic diseases, stem cell research, genetic engineering and organ transfer are all now available for consideration and the ethical issues rationally discussed by those involved. Geneticists engaged in these operations are no longer depicted as having evil motives but as benevolent doctors assisting families in distress. Ricki Lewis' (2008) novel *Stem Cell Symphony* communicates both concepts and the socio-political issues, enacting a resolution of the impasse between researchers and those categorically opposed to stem cell research on religious or humanitarian grounds.

Environmental issues

A major factor leading to the reinstatement of scientists is the emphasis on environmental recovery. During the 1970s and 1980s, scientists were implicated in environmental contamination by pesticides, radioactive waste and fallout from power-station accidents, toxic chemicals, monoculture farming, hormonal feed supplements, and so on. Although the research for these was, and still is, necessarily conducted by scientists, these evils are now more commonly laid at the door of pharmaceutical and mining companies, medical research laboratories, gene banks, agri-business, politicians and other power groups. Scientists, by contrast, are now perceived as essential allies in rescuing Nature, reducing pollution and devising new methods of generating environmental friendly power. Only they have the knowledge to do so. Altruistic, well-intentioned scientists in films have been increasing: the virologists of *Outbreak* (1995), the medical researchers and public health officials of *Contagion* (2011) striving to avert a potential viral pandemic spread by fomites and the scientists of *Avatar* (2009) intent on saving the moon Pandora from environmental degradation by military forces. Scientists are now frequently presented as environmental warriors educating society to the dangers being perpetrated on the planet and its creatures.

Female scientists

Because they are of recent origin and were never part of the alchemist stereotype, female fictional scientists, far from being mad or evil, usually resolve problems, despite attacks on their work and their integrity. And there have been increasing numbers of them. Ecologist Hope Clearwater (1990) of *Brazzaville Beach*, Ellie Sattler (1993) in *Jurassic Park*, astronomer Ellie Arroway (1997) of *Contact*, marine biologist Piyali Roy (2005) of *The Hungry Tide*, Grace Augustine (2009) in *Avatar* and animal linguist Isabel Duncan (2010) of *Ape House* all exemplify highly motivated scientists

of impeccable integrity. Many of the Lab Lit scientists, too, are women – Christina Arenas (2001) of *Carbon Dreams*, Clare Cyrus (2010) of *The Honest Look*, Gina (2009) of *Experimental Heart* and Jeannette of *The Falling Sky* (2013).

Conclusion

The above factors have been major contributors in eroding the formerly predominant stereotypes of the scientist as either comic failure or sinister researcher. However, there is another cogent reason for the recent demise of the ‘mad’, evil scientist: decreased reliance on scientists to represent the feared ‘Other’ and provide the situations and objects of dread that inspire horror films. There are now alternative ‘competitors’ for that role: insane gunmen, religious fanatics, terrorists, extortionist companies, destroyers of the environment and passionate, violent adherents of many persuasions from animal rights to right-to-life protesters.

Since 2001, we have learned to fear most the terrorism and fanaticism arising from political systems and fundamentalism and, underpinning them, the unpredictable madness of despotic or fanatical leaders. As before, the psychology of the unbalanced, evil mind is the real and abiding source of fear, but this is no longer attributed to scientists. The ‘popularity’ of the mad scientist as both fictional character and movie star has declined because we no longer need him. The new face of terror is the terrorist.

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Notes

1. There have been at least 142 film versions of *Frankenstein*. See, for example, knarf.english.upenn.edu/Pop/filmlist.html (accessed 2 January 2014).
2. Bert Wilde is a ruthless and fraudulent palaeontologist in Jon Kalb’s (2007) novel *The Gift*.
3. Geoffrey Chaucer (c. 1475) ‘The Canon’s Yeoman’s Tale’ in *The Canterbury Tales*.
4. Sir Nicholas Gimcrack of Thomas Shadwell’s (1676) play *The Virtuoso* was the first and most influential virtuoso character, but there were female virtuosae as well; see Haynes (1994: 35–49).
5. Jonathan Swift (1726), *Gulliver’s Travels*, Book II.
6. See <http://www.youtube.com/watch?v=7JDaOOw0MEE> (accessed 2 January 2014).
7. Seneca attributed to Aristotle the saying, ‘No great genius has ever been without some touch of madness’. Seneca, ‘*de tranquillitate animi*’, *Moral Essays* 17:10; see Stiles (2009: 318–322).
8. In *The Island of Lost Souls* (1933), Moreau’s creation of the Beast People involves vivisection, transfusions and ‘ray-baths’. In *The Island of Dr. Moreau* (1977), it is a bestializing serum; in the 1996 re-make, it is genetic engineering.
9. Enrico Fermi was recorded as saying about the bomb, ‘Don’t bother me with your conscientious scruples. After all, the thing is beautiful physics’, and Richard Feynman described the trance-like effect of research: ‘We started for a good reason, ... And you stop thinking, you know, you just stop’ (The Editors of *The New Atlantis*, 2005: 139). J. Robert Oppenheimer wrote of the H-bomb, ‘When you see something that is technically sweet, you go ahead and do it and you argue about what to do about it only after you have had your technical success’ (United States Atomic Energy Commission, 1954: 81).
10. *Wonders of the Solar System* (2010), *Wonders of the Universe* (2011) and *Wonders of Life* (2013).
11. Wells’ (1909) *Tono-Bungay* and *Ann Veronica*, Sinclair Lewis’ *Arrowsmith* (1925) about a medical researcher, and Nigel Balchin’s (1943) *The Small Back Room*, which explored the feelings of a weapons research scientist during World War II are the best known of these.
12. For this work, Nash shared the Nobel Prize in Economic Sciences in 1994.

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Author biography

Roslynn D Haynes is Adjunct Associate-Professor of English at the University of New South Wales, Australia, and an Adjunct Associate at the University of Tasmania. She is a Fellow of the Australian Academy of the Humanities. She has degrees in both science (biochemistry) and literature and is particularly interested in interdisciplinary research. Her publications include *From Faust to Strangelove: Representations of the Scientist in Western Literature* (Baltimore and London, UK: Johns Hopkins University Press, 1994), *Explorers of the Southern Sky: A History of Australian Astronomy* with Haynes RF, Malin D and McGee R (Cambridge, UK: Cambridge University Press, 1996), *Seeking the Centre: The Australian Desert in Literature, Art and Film* (Cambridge, UK: Cambridge University Press, 1998), *Tasmanian Visions: Landscapes in Writing, Art and Photography* (Hobart, Tasmania: Polymath Press, 2006) and *Desert* (London, UK: Reaktion Press, 2013).