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Fantastically reasonable: ambivalence in the representation of science and technology in super-hero comics

Simon Locke

A long-standing contrast in academic discussions of science concerns its perceived disenchanting or enchanting public impact. In one image, science displaces magical belief in unknowable entities with belief in knowable forces and processes and reduces all things to a single technical measure. In the other, science is itself magically transcendent, expressed in technological adulation and an image of scientists as wizards or priests. This paper shows that these contrasting images are also found in representations of science in super-hero comics, which, given their lowly status in Anglo-American culture, would seem an unlikely place to find such commonality with academic discourse. It is argued that this is evidence that the contrast constitutes an ambivalence arising from the dilemmas that science poses; they are shared rhetorics arising from and reflexively feeding a set of broad cultural concerns. This is explored through consideration of representations of science at a number of levels in the comics, with particular focus on the science-magic constellation, and enchanted and disenchanting imagery in representations of technology and scientists. It is concluded that super-hero comics are one cultural arena where the public meaning of science is actively worked out, an activity that unites “expert” and “non-expert” alike.

1. Introduction

This paper offers a contribution to the development of more informed and sophisticated understandings of popular science, through a specific focus on super-hero comics, inspired by the scholarly effort to move away from the established model of science popularization, the so-called “canonical account” (Shapin, 1990), or “dominant view” (Hilgartner, 1990; cf. Lewenstein, 1995; Bucchi, 1998). It is taken as given that this model is inadequate and that there is a need for better knowledge of the forms and features of popular science, including the sorts of fictional representations found in popular cultural media such as super-hero comics. Related to this, the paper presents a critique of two traditional views of the impact of science on the mental outlook of the ordinary person in modern society. One, disenchantment, asserts that magical outlooks and orientations are supplanted by rationalized scientific ones, whilst the other claims to the contrary that science itself becomes a focus of

enchantment, akin to a new religion or sacred order. Despite this difference, however, both make similar assumptions to the canonical account of science popularization involving a view of science as active and monolithical in its impact on a passive, or at best merely reactive public. Against this, and in accord with a view of the public uptake of science as active and “multiplex” (Wynne, 1993), the paper argues that the question of whether science disenchantments or enchants should be seen as one dimension of public ambivalence as found in other contexts (Irwin and Wynne, 1996).

The example of super-hero comics supports this argument. Super-hero comics are a valuable if neglected focus for research in popular science, drawing on science in ways that are far more sophisticated than some earlier studies suggested (contrast Basalla, 1976, with Oehlert, 1995). Like other forms of fictional representation of science (Goldman, 1989; Lambourne et al., 1990; Haynes, 1994; Jancovich, 1996; Skal, 1998; van Dijck, 1998; Turney, 1998; Vieth, 2001), super-hero comics deal with questions about the social and cultural meaning of science that are constituted out of the same basic stuff as academic concerns—that is, available cultural resources that provide the means of thinking (Locke, 2002; cf. Billig et al., 1988; Billig, 1996). The paper aims to demonstrate in this respect that the issue of the disenchanting or enchanting character of science is one that super-hero comics address at a number of levels, from basic features of their generic form, through to specific characters and story lines. Science, or its representation, is central to the constitution of the fantasy worlds (“universes”) that super-heroes inhabit. Two main points of focus serve to bring this out: *continuity*, the term used by fans and publishers to refer to the coherence of the internal history and workings of super-hero universes including the “biographies” of individual characters; and *origins*, that is the way super-hero characters gain their powers and become “super.” Continuity and origins are closely interlinked as a character’s origin effectively locates them in the super-hero universe and defines who and where they are in relation to established characters, events, and plot lines. An important feature of origins is that they are drawn from a range of cultural resources, including science, but also magic, religion, myth, legend, folklore and so on. Consequently, an issue arises about how these various dimensions or forms of culture stand in relation to each other. This is dealt with in the comics in a variety of ways at a number of levels and the paper looks in detail at four aspects: the science-magic constellation; varieties of enchanted states; technological reductionism; and variations on the character of the scientist. These aspects are selected principally for their relevance to the issue of ambivalence in the popular meaning of science—ambivalence that is also apparent in the academic views to be considered first.

2. Disenchantment versus enchantment

A prevalent view of the public meaning of science in contemporary social theory is marked by a set of assumptions about science and its impact on the mental state of the ordinary member of modern society rooted in Max Weber’s (1948: 139) thesis of “intellectualist rationalization”:

Let us . . . clarify what this intellectualist rationalization, created by science and by scientifically oriented technology, means practically. Does it mean that we . . . have a greater knowledge of the conditions of life . . . ? Hardly. Unless he is a physicist, one who rides on the streetcar has no idea how the car happened to get into motion. And he does not need to know . . . It means . . . the knowledge or belief that if one but wished one *could* learn it any time. Hence, it means that principally there are no mysterious

incalculable forces that come into play, but rather that one can, in principle, master all things by calculation. This means that the world is disenchanted.

Weber's stress on the lack of need for ordinary people to know much about the content of science is prescient in the light of recent debate, but the view that science impacts on people in a uniform or monolithic way to produce a generalized condition of disenchantment is more questionable (Locke, 2001). Like the canonical account of popularization it assumes that people are essentially passive recipients of science to be shaped in its mold. As is now well established, this is overly simplistic, which is not to say that disenchanted responses to science do not occur. A link can be made here to theories of technical and/or technological reductionism, which see science as underwriting a diminished sense of human and social being reducing it to a "one-dimensional" (Marcuse, 1964), machine-like measure. This kind of imagery is very common in super-hero comics, as in other forms of science fiction (Goldman, 1989; Lambourne et al., 1990; Haynes, 1994; Jancovich, 1996). We might then take it that such images demonstrate the validity of the thesis, reflecting and reinforcing the prevalent disenchanted state of mind. However, other considerations suggest otherwise.

In social theory itself, a contrasting view of the public meaning of science emphasizing the very opposite to disenchantment also appears. Collins (1985: 5–6), for example, uses the metaphor of a "ship-in-a-bottle" to describe the way science appears to those excluded from the inner workings of the scientific community, which in his view means most of us most of the time. The metaphor conveys the point that there are "profound mysteries" (p. 5) surrounding the generation and maintenance of scientific knowledge, so that from the ordinary person's point of view, science appears wrapped in an aura of certainty—at least until the tricks involved are disclosed by the sociologist. So far from things seeming potentially knowable, how ships get into bottles appears an act of imponderable magic: "'Distance lends enchantment': the more distant in social space and time is the locus of creation of knowledge the more certain it is" (Collins, 1985: 145; cf. Collins and Pinch, 1993: 143). Accordingly, it might be anticipated that we should expect to find enchanted imagery associated with science in public contexts, as is most obvious perhaps in the common view of scientists as "wizards," or even priests of a new "sacred" order (LaFollette, 1990; Lambourne et al., 1990; Haynes, 1994; Skal, 1998; see also Bloor, 1976).

A variation on this theme associates science with a vision of the grand unification of knowledge (e.g., Lyotard, 1984), a view developed by Whitehead (1974) to provide an insightful analysis of science fiction. Although starting from Weber, she draws out a rather different set of implications, seeing rationalization fundamentally as "the transformation wrought upon concepts of the charismatic as man seeks to fashion from them an over-arching and universal system of meaning" (p. 553). So, rather than disenchantment, Whitehead finds the continuing presence of enchanted outlooks even within science itself—notably in positivism, marked by "both an attitude of adulation toward technologic possibilities and an attempt at a comprehensive understanding of the human situation" (p. 555). It is this attitude, she argues, that finds expression in science fiction: "The unarticulated charisma with which the Positivist [sic] endowed science and technological achievement was but a hair's breadth away from the more expressly magical fantasies which the science fiction writer wove into it" (p. 569). Science fiction is informed by the urge for a state of comprehensiveness achieved through the unification of all ways of knowing. This is especially apparent in the incorporation of "paranormal" and associated ideas and phenomena. These are versions of mystical states to suit a scientific context, recast by the science fiction writer, who "articulates feelings and ideas latent in the culture concerning the unknown, the improbable and the magical" (Whitehead, 1974: 570; cf. Lambourne et al.,

1990) and interprets them in modern terms. In this way, what are essentially magical visions of human potential attain a degree of “verisimilitude” and “scientific” plausibility. This point needs some stress as it leads away from concern with “accuracy” in the representation of science in favor of an interest in understanding how and in what ways science fictional scenarios may be made to seem plausible to their audiences (Cranny-Francis, 1998; Vieth, 2001; contrast Gresh and Weinberg, 2002). Fans of science fiction routinely employ distinctions between, for example, “hard” and “soft” science fiction, “science fiction” and “science fantasy,” “sf” and “sci-fi,” etc., referring in part to matters of plausibility, notably the extent to which the fictional world is grounded in currently accepted scientific knowledge (Hirsch, 1962; Clute and Nicholls, 1993; Lambourne et al., 1990). It goes without saying that the issue of plausibility is particularly pertinent to super-heroes.

It is clear from this brief consideration of academic views that science poses us questions over whether it disenchants or enchants, and, related to this, whether it reduces all things (most importantly human beings) to a single measure or provides a grand unification in which all ways of knowing are integrated. These questions are evidence of ambivalence about science and its meaning, dilemmas posed by the rise of science and the manner in which it is represented. From the present point of view, what is of interest is not to try to decide between them, but simply that science can be made out to fit either side. Taken as a whole, then, science would appear not to be (just) one or the other, but rather a set of potentials and possibilities towards both. The articulation of these potentials and possibilities provides alternative rhetorical resources that can be employed to present particular descriptions of science for different argumentative purposes. Accordingly, in articulating their divergent views of science and its public meaning, social theorists are themselves drawing on (and reflexively contributing back to) these resources. Thus, the contrasting models of rationalization can be viewed as alternative visions of science that we should expect to find at work (working through and being worked out) in popular culture as much as in the academic world—as indeed we do in the comics.

3. Super-hero comics

Before looking at the content of the comics a brief word about procedures is in order. First, a health warning: given the above argument, it would not be consistent for me to present what follows as anything other than a reading. I make no pretence to provide a definitive account of representations of science and technology in super-hero comics. Apart from any metatheoretical reasons there might be for this, there are also some very practical ones. Super-hero comics have been published on a regular basis (roughly monthly) since June 1938, with numerous titles appearing every month. There are literally thousands of issues available for study (potentially—many are effectively beyond access because of their rarity and cost), including hundreds of titles, characters, and stories. So, at best, the lone researcher can hope only to review a fraction of this number. Moreover, the present account cannot even claim to be based on a systematic sample, being drawn from a personal stock of knowledge accrued from many years of reading and collecting super-hero comics and should be viewed as preliminary at best. The choice of material is directed by the issues raised above and the reading is deliberately selective and partial, intended only to bring out some relevant features. There is much more work to do and this account does no more than build on some valuable starts made elsewhere (Reynolds, 1992; Oehlert, 1995; Rhodes, 2000).

My reading is also directed by some principles of rhetorical analysis, by which I mean three main things:

- (a) rhetoric as a general perspective treats specific representations of science and technology as selected from a range of possible representations that are positioned in (variable) relations of tension. Accordingly, I take it as given that any particular representation functions in effect as an argument (albeit unstably) and, whether intended as such or not, may be treated so heuristically (Gross, 1996);
- (b) rhetoric as specific formulations attends to the particular features from which representations are constructed. Given (a), representations are assumed to be formulated to do particular work in relation to their context of presentation; thus, their construction may be unpacked to identify particular rhetorical features and show their workings. For this, I employ an eclectic array of techniques, including, amongst other things, aspects of narrative analysis, use of metaphor and metonymy, and semiology (Potter, 1996);
- (c) rhetoric as dialogical relation between writer and reader (or producer and audience). Texts are persuasions, that is, constructed to encourage readers to take up particular (in effect, argumentative) positions (again, unstably) (Vieth, 2001). I assume that texts are recognizable as such to readers/audiences in that they are constructed from widely available elements and devices of persuasion. Accordingly, texts/authors may invite readers to view one position more favorably than others, or they may invite them to consider choices between positions, or any number of other stances, but whether or not and in what ways readers respond to such invitations is a separate matter. Suffice it to say, whether or not texts are successful in their suasions is always an open question.

Super-hero comics are an especially valuable focus for analysis, because of their low status in the society that gave rise to them. They are the thrice damned of Anglo-American culture: damned as *culture*, being popular not “high”; damned as a *medium*, being neither art nor literature but some perverse hybrid, at best suitable only for children (and retarded adults), at worst positively harmful (Barker, 1989); and they are damned as a *genre*, being the most outlandish fantasy involving absurd characters acting in the most bizarre fashion—the very antithesis, one might think, of plausibility. To find, then, in super-hero comics similar ambivalences about science to those found in academic discourse would provide strong support for the claim that we all draw from the same rhetorical well.

In inception, super-hero comics are usually viewed as an American phenomenon dating from the first appearance of Superman in *Action Comics* 1 (June 1938). The success of Superman led to the creation of numerous other characters cast in similar “super” mold in what became a rapidly burgeoning industry that, although currently experiencing something of an economic downturn, remains an enduring feature of contemporary popular culture.¹ Superman is often said to be an “archetype” and, although many later heroes vary considerably in the source and nature of their powers, the character is of sufficient significance to consider further here. In particular, Superman provides a good illustration, at least in one form, of the science-magic constellation that is a key feature of super-hero comic-book universes and so can be used to introduce a fuller discussion of this aspect in relation to the enchantment/disenchantment complex.

The science-magic constellation

In his structuralist study of super-heroes, Reynolds (1992) highlights the centrality of the conjunction of science and magic to their constitution. In the case of Superman, however, he tends to emphasize the “magic” more than the “science” in his focus on mythological and

religious parallels with the character. Thus, Superman's origin—sole survivor of a dying planet, blasted off into space in a rocket by his father in a final desperate act—has parallels with the Judaeo-Christian story of Moses as well as sun-god myths. The parallel with Moses is bolstered by the Jewish backgrounds of Superman's creators, Jerry Siegel and Joe Shuster. Reportedly, Siegel made explicit reference to mythological influences in describing Superman's creation, including Hercules and Samson (Catron, 1996). In early stories mostly written by Siegel, Superman is frequently referred to as a very strong man, even taking on the role of a circus strongman in one story, where he is advertised as "a modern Hercules" (Siegel and Shuster, 1938b: 6). This stress on strength is important as it points to the "scientific" aspect of the character. For all the mythological parallels, Superman can also be seen as a hero of an industrial age. Siegel and Shuster are often described as working class in their backgrounds, hailing from Cleveland, Ohio, in the industrial heartland of the United States. In his early adventures, Superman shows some of the qualities of a working class hero battling corrupt businessmen, industrialists, lawyers and politicians, as well as organized crime and (occasionally) mad scientists. Viewed in this light, Superman's strength and "toughness" represent an idealized image of masculinity that might resonate with manual workers (Willis, 1977) and his vigilante-style justice is in keeping with a tradition stretching back to the American frontier (Inge, 1990).

Of greater interest is a second way in which science is incorporated into the character as legitimizing his super-strength. Siegel and Shuster were fans of science fiction that began to flourish in America in the pulp magazines of the 1930s, even starting their own fanzines. An early editorial development of the pulps was a stress on scientific plausibility and Siegel and Shuster show a similar concern in the presentation of their character. On the opening page of *Action Comics* 1, two types of scientific reference appear. First, a highly compressed version of Superman's origin is recounted that describes him as coming from a planet with a human race "millions of years advanced" (Siegel and Shuster, 1938a: 1) of Earth. Superman's powers are due to his advanced "physical structure" (p. 1). Second, under the heading "a scientific explanation of Clark Kent's strength" (p. 1), an analogy is made with insects—grasshoppers and ants—that display apparent "super-strength" in being able to leap relatively great distances and lift relatively huge weights—just as Superman leaps tall buildings and out-powers locomotives. It is easy to dismiss all this, as does Reynolds (1992: 10), as "hokum," but a more sympathetic view would see it as an example of the use of popular science of the time, specifically eugenics (Nelkin and Lindee, 1995). An important feature of this was the linking of theories of evolution with notions of progress and advancement, for which there was much professional scientific support. Hence, the idea that human beings would evolve into more perfect physical specimens was both common and plausible. What Siegel and Shuster add to this is a translation of evolutionary time into interplanetary space, postulating an alien world where anticipated human development is further advanced. They give this a "working class masculinist" spin, highlighting physical strength rather than, say, mental power. Finally, in striking an analogy with homegrown insects, they bring the imputed evolutionary development back down to earth attempting to invest it some believability.

One caveat needs to be stressed. I do not intend this argument to be taken to lend support to the long-standing criticism of super-heroes linking them to the *Übermensch*. This dates back at least to Wertham's (1955) (in)famous critique of American comics, a critique that itself needs to be understood in the context of the immediate aftermath of the war against Nazism. It is perhaps unsurprising that the evident parallel between German and American ideas of the "superman" should be drawn and both visions vehemently rejected. Clearly, a case for such a parallel can be made as both show, at least to some extent and in

some form, the influence of eugenics. But we should not be blind to equally evident differences, the most obvious of which is that the early super-hero comics are replete with stories of heroes fighting the “Axis” nations. Superman was again something of a trendsetter, as his very first adventure, serialized in *Action* 1 and 2 (July 1938), shows him smashing a spy-ring on the home front before pursuing the plotters back to an ongoing war overseas. Fighting “fifth-columnists” and the “Japanazis” was standard fare of early super-heroics.

Story content is often neglected by critics of comics (Barker, 1989), but is vital to understanding the science-magic constellation. Although science is important in establishing the plausibility of Superman, it is significant that super-heroes are often thought of as “science-fantasy,” or at best “borderline-sf” (Clute and Nicholls, 1993: 1179). In the case of Superman, the magical aspects of the character come through in a number of ways that invest a sense of enchantment. Most obvious are Superman’s “paranormal” powers. However “scientifically” grounded, they set the character apart and are often the main focus of his adventures, both in terms of story plots and panel lay-outs. Readers are invited to take up and revel in a sense of wonderment at Superman’s feats, which are frequently described in hyperbolic terms, accentuating their out-of-the-ordinary nature; often they are explicitly described as “miraculous,” while, in some early stories, the character himself is sometimes referred to as a “legend.” Indeed, the language of super-hero comics is marked by strong religious—specifically, biblical—tones (Reynolds, 1992).² Following Reynolds, this enchanted theme can be pressed further. Metaphorically, Superman is the son of heaven; as such, he is a bringer of divine vengeance to the evils of the world. Significantly, in the early stories, he was a vigilante figure, working outside the law without official sanction and regularly breaching established rules and regulations—even to the point of acting as a literal executioner! Given his later image, as a “super-boy scout” embodying “truth, justice, and the American Way,” it is somewhat surprising to discover the character’s outlaw pedigree (Waid, 1997). The early Superman acts as representative of an other-worldly order, a bringer of divine retribution from a higher, “sacred” power. He is above the law because he represents a “purified” form of it. This is further signified by his dual identity. When Clark Kent changes to Superman, a moment of transformation is enacted, a shift from the mundane order of the everyday, profane world to the extra-ordinary “super-reality” of the sacred, signified by the change from earthly clothing to colorful costume, brighter and larger than life. It is a metaphorical metamorphosis of the mundane self into the magical imago-self, the inner spirit being.

Continuity and origins

The meeting of science and magic in the comics is also apparent in the fascinating mix of characters and settings drawn as much from science as from the more fantastical sources of magic, myth, and legend. As such, super-heroes present an array of enchanted images of science and technology, offering richly imagined transformations of the (purportedly) “real” world, constructed from certain of its elements and commenting upon it in a variety of ways. What matters in this respect is not how “accurately” they present science, but how they change it.

Important here is continuity. At one level, continuity refers to the coherence and consistency between stories involving *one* particular character, such as Superman. However, because super-heroes inhabit fantasy worlds that transcend individual characters, continuity also covers consistency *between* characters across a range of titles published by one publisher. Superman, owned and published by DC Comics, occupies the same comic

universe as Batman, also owned and published by DC, along with many other characters. Similarly, Spider-Man, owned and published by Marvel Comics, occupies the same universe as the X-Men and the Hulk, to name but two. Further complicating matters, individual characters frequently crossover into each others' comics, thereby establishing elements of shared biography that may be referred to in later adventures. Some titles consist completely of such shared adventures and thus occupy a central position in defining common points of reference that build into a history of that particular super-hero universe. An interest in continuity is one of the major foci of super-hero fans' relation to the comics (Pustz, 1999; cf. Jenkins, 1992) and has inspired efforts by creators (i.e., writers and artists) and editors to "rationalize" their imaginary universes by elaborating their histories and the characters' inter-relationships. I use this term deliberately to convey the point that "rationalization" may refer to the attempt to *construct (a sense of) coherence* out of available cultural resources. This comes out in super-hero origins.

By "origin" is meant the events that led to a character gaining their super-power(s). Origins play a key role in defining characters and their place in the super-hero universe and, because of this, are another important aspect of fans' relation to the comics. A character's origin can be thought of as defining the initial *moment of transformation*, when their status as "super" is established, instituting a shift from the ordinary to the extra-ordinary. This is akin to the transformation wrought on mundane objects of the "profane" world through religious ritual to invest them with a "sacred" character (or, it might be suggested, the transformation wrought in science to make otherwise ordinary objects worthy of laboratory treatment—Knorr-Cetina, 1983). As suggested, origins provide opportunities for creators retrospectively to elaborate prior continuity often in ways that more deeply entwine characters together, thereby further cementing a sense of historical "facticity" to the fantasy universe. This extends to the universe itself. It is at this point that the sources of super-heroes' powers, their individual origins, and the demand for and interest in coherence generates a particular type of tension for creators to manage. Specifically, given that the cultural resources drawn on to provide sources of super-heroes' powers are multiple, ranging across science, magic, religion, mythology, and so on, the demand for continuity has led to creators seeking ways to construct forms of compatibility between these, at least to the extent of enabling them to coexist in the same imaginary "reality." Reynolds highlights this in the case of two characters, Iron Man and Thor. The former is very much a product of science and technology, being a sort of modern-day knight in armor, clad in a highly sophisticated metal suit powered by micro-electronic circuitry. The latter, on the other hand, is the Norse god of thunder. Both are members of one super-hero team, the Avengers, and come into regular contact with each other. In their everyday human identities, they are good friends. And yet, as Reynolds notes, Iron Man has often been shown troubling over the existence of Thor: how can he, a scientist, accept the presence of such an apparently supernatural being?

This kind of tension emerges at a more general level in the attempt to present a grand cosmological order for a given super-hero universe, as seen in the publication of guides and handbooks—and, in the case of Marvel, even a grand saga akin to a mythical creation story (entitled *Marvel Saga*, it ran for 25 issues between December 1985 and December 1987). Commenting on their procedure, the editor made the following remarks (in a section entitled, with apt irony, "Scientific Method"):

we examine our notes concerning the source, use, and extent of a given entry-subject's powers, in order to describe and quantify said powers. Often Marvel's all-around technical expert . . . is called in for some scientific consultation. The premise around

here is that the laws of physics apply to superhuman powers same as they apply to anything else. That is, unless the powers are derived from certain unexplainable phenomena (magic, psionics, extradimensional energies) that must somehow coexist with the science we know. Consequently, unless someone's powers stem from "mysterious" sources like those just mentioned, they are subject to the same laws of physics we are. That's where [the technical expert] comes in, helping us determine whether normal physics apply in a given case or not, and what the physical limitations would be. (Gruenwald, 1986a: inside front cover)

Significantly, despite the effort to find a scientific basis or plausibility for a character's powers, the existence of other sources is accepted, albeit as "unexplainable" and "mysterious." Thus, in super-hero universes beings transformed by science stand alongside beings transformed by magic collectively occupying a single, coherent "reality." Moreover, this "reality" is itself represented as a transformed version of our "actual" reality, as is apparent from the effort to establish scientific plausibility where possible. Nor should it be thought that this feature is old-hat. Although attempts to construct such overarching continuities seemed to reach a peak during the 1980s, the meld of science and magic persists. To take just one example, the British writer Alan Moore has recently established his own universe of super-hero characters for which he has coined the term, "science-heroes." The term is applied even to the heroine, Promethea, a being of magic who embodies the spirit of imagination and whom Moore uses to elaborate a cosmology based on the Kabbalah into which science—and the scientific worldview—is itself positioned (Moore and Williams III, 2001).

Thus, science becomes enchanted, just as magic is "scientized," a unification that would seem to be in keeping with Whitehead's "universalizing" interpretation of rationalization. That this manifests in ostensibly fictional contexts presents a curious irony, but that it remains an important feature of popular culture needs emphasis. Nonetheless, other ways in which enchanted imagery of science appears expose some of the tensions present and begin to point towards an alternative conception that resonates rather more with disenchantment. To consider this, I will focus on the Marvel Comics universe.

4. Science and magic in Marvel

Marvel is famous for having significantly reworked the super-hero genre in the early 1960s, by giving its heroes "problems," making them seem more realistic to many readers. One feature contributing to this is the way in which science and technology are depicted.

Atom-age heroes

Appearing in the post-atomic era, many Marvel characters owe their origins to transformations wrought by radiation; as such they represent in a variety of ways the ambivalence toward atomic power that was a major theme of 1950s science fiction (Tudor, 1989; Lambourne et al., 1990; Haynes, 1994; Skal, 1998). A classic example is the Incredible Hulk, the monstrous green-skinned entity created when Dr. Bruce Banner was accidentally caught in the explosion of a "gamma bomb" of his own invention. The Hulk is the Mr. Hyde of the atomic age, his strength and fury all the greater for being powered by nuclear rather than merely chemical energies.³ But the magical transformation is the same, as is the ambivalence about science as a source both of tremendous power and of equally tremendous threat.

Rather different are the X-Men, whose various mutant powers result from the chance effects of radiation on their parents' reproductive systems and who therefore represent the next stage of human evolution, "Homo superior." The science here shares something of the vision of evolutionary development seen in Superman, but with the X-Men this takes an altogether darker tone, as befits the post-eugenic period (van Dijck, 1998). Unlike Superman's status, the X-Men's status as outlaws is a result of their rejection by society—the very society they seek to protect from others of their kind whose resentment towards *Homo sapiens* becomes a motive for mastery. Thus, in *The X-Men* science becomes a means whereby writers can explore themes involving racial tension as well as the more traditional complexities of vigilantism.⁴

Different again is Spider-Man. In the early 1960s' comics, Peter Parker is a typical teenage nerd more at home in the science laboratory than with his fellow high school students. Being bitten by a "radioactive spider" at a science exhibition and subsequently gaining spider-powers merely adds further layers of complexity to his already troubled life as he learns that "with great power there must also come—great responsibility" (Lee and Ditko, 1962: 11).⁵ But his powers are also a fantastic outlet and compensation for his teenage "neuroses" and the stories are as much an exploration of his relation with being super as they are with the traditional activity of heroism. Moreover, in being both a science student (as Parker) and a product of science (as Spider-Man), science is deeply implicated in this relation as both a focus of personal desire and a source of personal trouble—and, often, the means of resolution (more on this below).

Cosmic beings

Alongside the atom-age science, Marvel creators also drew on more explicit magical and mythological imagery for other types of character. In addition to god-like beings such as Thor, other characters, such as Doctor Strange, the "Sorcerer Supreme" of Earth, owe their powers to the occult. Indeed, as the Marvel universe grew during the 1960s and 1970s, whole pantheons of god-like beings, drawn from the religions and mythologies of the world were incorporated into its continuity. These drew on traditional religious and mythological beliefs—taken from around the globe in a sort of multi-cultural ecumenicalism (or ideological neo-colonialism?)—but also modified them with developments in the wider culture, such as from "fringe" science. One example is "space-gods" (a term associated with von Däniken, 1969) incorporated into the Marvel universe during the mid 1970s in the form of the Celestials, a race of ancient space-farers responsible for originally seeding life on Earth. Amongst the forms of humanity created by the Celestials were the Eternals, a race of immortals who closely resemble the gods of Ancient Greece—and, hence, in the Marvel universe's history, account for belief in such beings. However, the "actual" Greek gods (i.e., the Marvel version of them) had already been included amongst the pantheons of super-beings occupying Marvel reality, generating a continuity problem over the relation between the two. This can be thought of as a "Marvelized" version of the wider cultural question of the relation between a scientific understanding and ancient beliefs. However "fringe," the idea of "space gods" is one that is possible and can have resonance only in a modern scientific culture; in this sense at least, it is a "scientific" account of ancient beliefs and thus stands in relations of some tension with them. This tension is played out in the super-hero fantasy universe and thus invites efforts at exploration and resolution.

Other ways in which such tensions appear are in specific types of character who themselves embody aspects of a modern scientized worldview. Science is often distinguished from traditional beliefs by its supposedly impersonal nature (Horton,

1982)—traditional beliefs are held to express abstract principles in the form of mythological beings who are often as capricious in their personalities as ordinary people, whereas science speaks of abstract forces and causes that are neither personalized nor ascribed human qualities—a view clearly linked to disenchantment. In super-hero comics, however, abstract ideas are often personalized by being embodied in specific characters—a further aspect, then, of their enchantment. Such personalization applies even to the highest level of abstraction, as in a character called the Beyonder who is the human-like embodiment of an alternate universe—in effect, therefore, God. At only a slightly lower level is the character Eternity, who is described as “the sentient life force of the universe . . . as much abstract concept as actual entity. . . . [T]he collective consciousness of all the life forms of the universe” (Gruenwald, 1986b: 33).

A roughly comparable figure is Galactus, the sole survivor of the universe that existed prior to the present (i.e., Marvel) one. As such, strictly, Galactus is perhaps less a personification of an abstract concept than representative of a notion of universal transcendence. His origin draws on the contemporary scientific cosmogony of the “Big Bang”:

Originally . . . a “Cosmic Egg”, a primal sphere of disorganized, dense, compact primordial matter . . . underwent a “Big Bang” . . . expanded . . . and . . . contracted over the following billions of years. . . . Galan, a space explorer . . . travell[ed] in a starship straight into the “Cosmic Egg”. . . . [T]he sentience of the dying universe . . . prevented Galan . . . from being destroyed . . . telling him that they both would die, but . . . be reborn, and that Galan would thus become Galactus, ravager of worlds. (Gruenwald, 1986b: 63)

It might then be said that Galactus represents Marvel’s take on science’s creation myth, personifying and thereby investing it with something of the spirit of enchantment. As such the imaginative construct of Galactus is both of science and not of science, within science and transcendent of it, scientized and yet wholly other. This points to an important way in which science is perceived and understood within popular culture and some of the peculiar tensions within this.

Other tensions, of a more familiar Promethean form, are represented in another character, the Watcher. The Watcher is a member of an ancient alien race who long ago attained a level of cosmic transcendence through scientific and technological mastery. After much deliberation, they decided to share their knowledge with other, less developed peoples, only for this to end in disaster, as a result of which the Watchers swore to abstain from interference, merely observing and recording the doings of others. Thus, the Watcher represents both the triumph and disaster of scientific intervention, the resolution of which is a state of passive, pure observation—a sort of ideal empiricist. It is notable, however, that the Watcher dresses in robes reminiscent of Graeco-Roman civilization, giving him something of the bearing of a wise philosopher, or even a guardian angel and, despite his oath, he often acts toward Earth in this way. He is, then, another amalgam of science and religion, embodying dilemmas of both.

One level of interest in such characters is that they represent ways in which aspects of scientific culture become the materials out of which alternative imaginary constructs are generated. In being personalized, such constructs engage a mode of sensibility that is ostensibly at odds with a modern scientific state of mind—at least in so far as this is defined in terms of disenchantment. Further, this personalized form is crucial to the workings of super-hero comics in one particular respect involving what Lessl (1989: 190–1) calls “consubstantiality,” or what might be referred to as the *cosmic connection*, where “sacred” and “profane” are brought into contact. This involves

two directions of transference . . . (1) Elements of the scientific that overlap with ordinary experience are drawn upon in an effort to humanize the otherwise alien world of scientific objects, and; (2) elements of ordinary human experience that coincide with specialized scientific norms and values are reconstructed so that they achieve scientific meaning. (Lessl, 1989: 190–1)

These two directions are represented metaphorically by the transformed condition of super-heroes, through which ordinary people come into contact with the enchanted order represented by cosmic beings. The archetype of this is Clark Kent, whose meek and mild persona throws into sharp relief the forceful self-confidence of his powerful alter-ego. Kent's Marvel equivalent is Peter Parker, who converts from a puny bookworm into the wall-crawling, wise-cracking Spider-Man. Such characters represent the vision of hidden power that science promises to release and control. At the same time, in encountering cosmic beings, super-heroes are also used to express a sense of awe and wonder at the scientized cosmic order, in the face of which ordinary people can appear tiny and irrelevant. Super-heroes thus represent the possibility of a mediating condition, in which the transcendent, enchanted order is made human, even as humans are brought into humbling contact with it.

Techno-magic

Making contact with the cosmic order often involves more than just becoming super-powered; it also involves a journey. This is a standard motif of folktales involving contact with other realms or realities, which finds parallels in modern scientific texts as well as super-hero comics. In Propp's (1968) analysis of traditional Russian "wondertales," a journey functions as the means whereby the hero is brought to an alternate, often magical, context where a significant change or transformation can take place (see also Lambourne et al., 1990). This is sometimes the case with super-heroes, too. For example, the Fantastic Four gained their powers through a journey into space in an experimental rocket ship (back in 1961). Outside the Earth's atmosphere, they were struck by "cosmic rays" that penetrated both the ship's hull and their bodies, transforming them into super-beings.⁶ The journey then functions as a metaphor for the transformation, the movement from the ordinary to the extraordinary.

Journeys sometimes play such a role in science, too, as metaphors for the transformation of states of understanding and thus as ways of moving from the conventional, accepted state to a previously unknown and thus extra-ordinary state (Brown, 1992; van Dijck, 1998). In the case of science, such a transformation might be viewed as progress in the advancement of knowledge, a move from an inferior or lower condition to a higher, superior one—from "profane" to "sacred." This function has a parallel within comics, too, when super-heroes undertake journeys, as they generally must, to encounter the higher beings that embody the cosmic order of the super-hero universe. Significantly, such journeys often require the use of advanced technologies, which thus become imbued with an enchanted character, as the means whereby the higher state is attained. One example of this is in *Thor* 167. Thor is charged by his father, the all-powerful Odin, to undertake a journey into deep space to find Galactus. Despite the fact that Thor is himself a god and thus already enchanted, and also that he has his own means of travel in the form of a magic hammer, Mjolnir, Odin tells him that he must travel in a special "ship." This is depicted in surreal high-tech form and fills Thor with "awe," because it is "invested with [Odin's] power" (Lee and Kirby, 1969: 10), evidently a notch higher up the scale of enchantment. Thus, only by using that which already partakes of the higher order may the higher state be attained. (It is

tempting to strike a further parallel with the high-tech apparatus employed in the scientific laboratory which metaphorically represents the means of “travel,” via the scientific method configured in the technology, to attain valid knowledge of reality. For a treatment of technology as text, see Grint and Woolgar, 1997.)

Such uses of technology are one way in which super-hero comics display the adulation of technology that Whitehead associates with positivism. This also appears in cases where technology is used to resolve story lines—not so much a *deus ex machina* perhaps as a *machina ex deus*! Again, a comparison with folktales can be made in that technology is something of an equivalent to the “magical agents” Propp identifies in wondertales (cf. Tudor, 1989; Lambourne et al., 1990; Haynes, 1994; Skal, 1998). Of these, Propp (1968: 50) writes that the “hero of a fairy tale is that character who . . . in the course of the action . . . is supplied with a magical agent . . . , and who makes use of it or is served by it.” Examples of this are common in the *Fantastic Four*, whose leader, Reed Richards is a brilliant scientist-inventor and frequently rustles up a convenient high-tech gadget to get the group of adventurers out of trouble. Or again, as sometimes happens, the technology is gifted by what Propp calls a “donor,” that is, a character, often themselves a magical being, who donates the magical agent for the hero to use. A good example of this appears in *Fantastic Four* 49 and 50. The Earth is under threat of destruction by Galactus, and the Fantastic Four, despite their great powers, are unable to stop him without the help of the Watcher. The Watcher sends their youngest member, the Human Torch, to retrieve an advanced technology called the “ultimate nullifier” (Lee and Kirby, 1966b: 8). This is kept in Galactus’ home, a giant “space station” to get to which the Torch must undertake an inter-galactic and inter-dimensional journey by “time-space distortion” passing through “the celestial barriers known as un-life” (Lee and Kirby, 1966a: 15–16). Like Thor, he must travel to enchanted realms by enchanted means in order to obtain the technological magical agent. Confronted by this weapon, Galactus quickly concedes defeat and departs “via dimensional displacement” (Lee and Kirby, 1966b: 10), leaving the awestruck Fantastic Four to marvel at his power.

However, as much as technology is represented as a source of wonderment, so also—and often at the same time—is it represented as a source of worry. Like traditional attitudes to magic, as both a potential source of help, but because of its powerful and uncontrollable nature also a source of trouble, the attitudes toward science and technology are ambivalent. Three ways in which troubles with science appear are: concern over cosmic indifference; resistance to technological determinism; and mad scientists.

Cosmic indifference

A recurring theme involving cosmic beings is the apparent indifference of such powerful entities and the forces they represent to “mere mortals.” This strikes something of a counterpoint to consubstantiality: instead of creating identification between the cosmic and the human, the gap is widened and the human reduced to a negligible irrelevance—which is how disenchantment is characterized in critiques of technical reductionism, as the effective negation of human qualities. This finds some expression in super-hero comics through iteration of themes that are reminiscent of the “two cultures” (Snow, 1964). The Fantastic Four’s encounter with Galactus again provides a good illustration. During the course of this story, the following exchange occurs between Alicia Masters (AM), a blind sculptress and friend of the Fantastic Four, and Galactus’ herald, the Silver Surfer (SS), who initially presents a pure efficiency principle:

SS: The process you term *eating* is far too wasteful! How much simpler it is to convert all those items into pure *energy*! For energy alone is . . . *power*! In this manner not a single gram shall be wasted! And the objects in this room . . . pictures, bits of sculpture . . . decorations . . . they are *all* wasteful! Before the great *Galactus* is done, *everything* shall be reduced to sheer *energy*!

AM: You . . . you *mean* it. In some mad, unbelievable, nightmarish way . . . you *mean* it! You intend to *destroy the earth*!

SS: *Destroy* is merely a word! We simply *change* things! We change elements into energy . . . the energy which sustains *Galactus*! For, it is only *he* that matters!

AM: No! *No*! We *all* matter! Every living being . . . every bird and beast . . . this is *our* world! *Ours*! Perhaps we are not as powerful as your *Galactus* . . . but we have hearts . . . we have souls . . . we live . . . breathe . . . *feel*! Can't you *see* that?? Are *you* as blind as *I*?? (Lee and Kirby, 1966a: 11; emphases and punctuation as original)

Touched by her words, the Surfer finds himself caught by unusual “emotions,” but he resists, reasserting his commitment to *Galactus*. Alicia tries once more to persuade him:

AM: But *look*! Look at the city below you! Look at the *people*! Each of them is entitled to life . . . to happiness . . . each of them is . . . *human*!

SS: *Human*? What can that word mean to *me*? And yet never have I beheld a species from such *close range*! Never have I felt this new sensation . . . this thing some call . . . *pity*! (p. 12; emphases and punctuation as original)

So, the Surfer finds “something worth protecting” (p. 20) and decides to oppose his master. In this exchange, then, the sense of cosmic indifference expounded by the Surfer is expressed through an idea of efficiency that reduces all things to a single measure, their energetic content. This includes, notably, works of art and living creatures, as well as humanity. All have only one type of value from the cosmic point of view, their energy to sustain *Galactus*. So is human life and work rendered effectively meaningless beyond the utilitarian principle. Against this, Alicia argues for the intrinsic value of life and of human life especially (albeit expressed in the discourse of Western Christian values), asserting its non-reducible quality. Notably, her words do enough to sway him.

Technological reductionism

The point extends also to the treatment of technological reductionism, where a contrast to the adulation of “techno-magic” is struck through themes that treat technology with greater skepticism. This feature comes out especially in stories and characters that emphasize the limited capacities of technology to “colonize” the human, as can be seen in the numerous examples of mechanized humans and humanized machines that people super-hero comics. Although technology is one of the means of transformation used to enable a character to become part of the super-heroic realm, it often comes at the price of a particular set of problems that engage issues of technological reductionism. For example, Iron Man, in his early 1960s incarnation, built his armored suit as an extension of an electronic chest-plate designed to keep his wounded heart beating, like an external artificial heart. In consequence, he was obliged to wear this part of the armor all the time and a major theme of his early adventures was the tragic isolation and alienation of the man within, a metonym for the modern condition of technological dependence.

An up-dated variation on this is the man-computer cyborg, Deathlok, who first appeared in 1974. Situated in a near future “time-line” of the Marvel universe, Deathlok was the product of an attempt to build a super-soldier by replacing damaged body parts with bionics, including a computerized brain. Unlike the enhancements of his televisual contemporary, the Six Million Dollar Man, Deathlok’s bionics are plainly visible, contributing to the character’s ambivalent super-heroic identity—as the cover blurb to his first appearance has it: “Is he man—or machine—or monster?” (Buckler and Moench, 1974). Also unlike Steve Austin (the Six Million Dollar Man)—and rather more like the later film character Robocop—Deathlok has a fractious relationship with the institutional authorities that created him, thematized through his struggle to override the computer’s programmed control of his actions. Thus, these stories deal with recurring science fictional themes of technological control and resistance, and explore issues of what it means to be human in relation to artificial intelligence (Goldman, 1989; Tudor, 1989; Lambourne et al., 1990; Haynes, 1994; Jancovich, 1996; Skal, 1998; van Dijk, 1998).

A different variation is found in the super-villain, the “Mad” Thinker. The Thinker presents an image of arch-positivism as he uses advanced computer technologies and mathematics to predict the course of events, including human behavior, down to the microsecond. But, although he enjoys a high degree of success in this enterprise, he is always undone in the end by the “X-factor—the unexpected! The human element!” (Lee and Kirby, 1963: 20)—that is, something essentially human that defies measurement and resists calculative control. Of course, the Thinker always returns undaunted to try again, each time with even more sophisticated techniques at his disposal, but as yet, the “X-Factor” has continued to defeat him (long may it do so!).

Similar issues are also played out in the reverse direction, in the form of machines that display human-like qualities. Two brief examples must suffice to illustrate this. First, there is the “synthozoid” Vision, an android-like entity constructed from synthetic parts, but imbued with the mind—or “brain-patterns”—of a man. Although the Vision appears to be almost robotic in character, apparently lacking identifiable human personality traits, the recurring question his stories address is whether he can experience emotions. In particular, the core plot involving the Vision is his on-again/off-again love affair with the mutant sorceress, the Scarlet Witch—a case of machine mating mutant magic, a hybrid relationship if ever there was one! (Oehlert, 1995).

A somewhat different character is Warlock, an alien being described as a “sentient form of ‘techno-organic’ life which resembles circuitry and machinery” (Gruenwald, 1987: 32). Warlock feeds by in-take of energy, which may be absorbed directly from technological sources such as electrical current, or from living organic material. Organisms must first be infected with a “techno-organic” genetic virus that reconstructs them into a compatible form allowing Warlock to absorb their “lifeglow” (Claremont and Sienkiewicz, 1984: 19). Like the Silver Surfer, then, Warlock would seem to encapsulate the “scientistic” view of life as essentially a form of matter reducible to energy. Moreover, as an entity apparently closer in form to technological than biological systems, Warlock might be taken to embody the “colonization” of life by machine. Such a reading, however, ignores the way the character is used and developed. Although alien, Warlock is a child, an orphan, and is presented as in need of socialization to learn what it means to be human—including, of course, that it is not nice to reduce people to their “lifeglow.” Moreover, as is said by one character, Warlock is “not a machine . . . he has feelings” (p. 27). Again, therefore, the character is a further working out of questions about the boundary between humans and technologies raising the problem of the proper relation between machines and society.

Scientists

The same types of issue also appear in representations of the character of the scientist, a point that needs stressing as it contrasts with an earlier view of the so-called “pop scientist.” Basalla’s (1976) “content analysis” of the image of the scientist in popular culture includes a number of references to characters in super-hero comics, his general conclusion being that the “portrayal of the scientist is remarkably consistent with an older tradition that saw the scientist as a dangerous figure who tended toward mental instability and social irresponsibility” (p. 263). The extent to which this does full justice to the range of images of the scientist in Marvel comics is questionable as can be seen by examining a few cases.

One character Basalla describes is Dr. Curt Connors, who first appeared in *Amazing Spider-Man* 6. Connors, a surgeon who has lost an arm, is depicted, as Basalla tells us, as “a devoted family-man and friend of the forces of good” (1976: 263). He has turned to biochemical experimentation hoping to discover how reptiles are able to regenerate lost limbs so that humans might as well. Thus, his motivations, whilst wildly ambitious, are explicitly intended for positive medical and social ends. However, Connors chooses to experiment on himself with the “serum” he develops—an act that could be viewed as dangerously irresponsible, but equally as selfless and noble. The serum (magically) transforms him into the Lizard, but the process is protracted, and he continues to struggle to find a counter serum even as his brain becomes duller, until he is too far changed to think clearly. Fearful of the danger he poses to his family, he flees into nearby swampland, where the Lizard persona takes over, plotting to use Connors’ solution to make reptiles intelligent so they might rule the world as once did the dinosaurs. Spider-Man, himself a brilliant science student, stops him by using Connors’ notes to concoct an “antidote” to the serum. The story concludes with Connors having learned his lesson: “I tampered with forces of nature which must not be tampered with!” (Lee and Ditko, 1963: 20).

Viewed in terms of mad scientist stereotypes, there are clearly discernible influences from Jekyll and Frankenstein (Tudor, 1989; Lambourne et al., 1990; Toumey, 1992; Haynes, 1994; Skal, 1998; Turney, 1998). But there are variations, too: Connors is not simply identical to either forerunner, and the variations are important in engaging our sympathy with his ambitions and providing the Lizard’s motivations. It is important also that Spider-Man is a scientist—and clearly he does not fit either the “pop” or mad image straightforwardly, as he is more of a savior-scientist figure (Haynes, 1994; Mellor, 2002). Neither is the story simply one of “good” versus “bad” science. Connors is not evil—not even as the Lizard if we consider his motivations to be those of a lizard! And the “good” science that saves him is itself an outcome of his own work. What is surely apparent is that the story is about the ambivalence of science. Like much other science fiction, the Lizard’s story is about the hope of science and its tragedy, its potential and capacity to produce both good and bad in seemingly equal measure (although arguably in the outcome, the “good” edges it) and from apparently the same source. The dilemma is compounded in that science is both the source of trouble and its (literal!) solution—an especially apt feature, as the story might be seen as symbolizing ecological problems that are caused, but must also be solved, by science (Yearley, 1991; cf. Tudor, 1989; Lambourne et al., 1990).

This also accounts for the variations in the character of the scientist. The “pop” scientist, contrary to Basalla, is not a simple stereotype, but a *complex of possible stereotypes*, a repertoire of features that may be drawn on selectively to depict a range of scientist-types to suit the specific role intended (cf. Haynes, 1994).⁷ This may be hero or villain, but many of the more striking characters in super-hero comics are morally mixed and

equivocal. Moreover, the repertoire is not static, but has changed over time, enabling more—and more complex—types of character to be drawn. This can be seen in another Marvel scientist, Dr. Doom.

Doom is in some ways a classic Faustian figure. He is archenemy of the Fantastic Four, especially their leader, Reed Richards. Richards himself is among the foremost of Marvel's savior-scientist figures and part of what fuels Doom's enmity is his desire to prove himself Richards' intellectual superior. The antagonism began when at college together, Richards discovered Doom working on "forbidden experiments" involving "matter transmutation and dimension warps" (Lee and Kirby, 1964: 9). Richards spotted some errors in Doom's "equations," but was arrogantly dismissed with dire consequences. The experiment exploded in Doom's face, scarring him physically and mentally, to the extent that he sealed himself inside a suit of armor, symbolic of his general alienation from the outer world and his particular hatred of the unblemished, handsome Richards. In contrast to a character like Iron Man, however, Doom's alienation is chosen: his armor also symbolizes his arrogant sense of superiority, his self-declared difference from normal society.

In this respect, the character's indebtedness to Faust is clear: Doom is a seeker of knowledge because he thirsts for power and refuses to be bound by the rules of ordinary society in his search. The boundary breached is that breached by the alchemist—the boundary between science and magic; the forbidden knowledge Doom seeks is sorcerous and he also has dealings with Mephisto, the Mephistopheles of the Marvel universe. Unlike Faust, however, Doom has not traded his soul for knowledge (at least, in no more than a metaphorical sense), nor is his earthly power temporally bound in the same way. Here, the character owes rather more to twentieth-century would-be world conquering mad scientists. Doom's dreams of power are to accomplish world domination—after he has beaten Richards. Thus, just as Connors is not simply identical to Jekyll or Frankenstein, nor is Doom simply Faust. He is, rather, Faust reworked in a modern context and further adapted to the genre of super-heroes. This is important because it shows that the character of the scientist—whether "pop," "mad" or otherwise—is tailored to suit the needs of the particular story and generic context. The repertoire of representations of the scientist is drawn on selectively and interpretatively to construct a character that is both easily recognizable in general form, but unique in the specifics. Doom is designed deliberately to strike specific contrasts with the scientist-hero, Richards, such that, like Spider-Man and Connors, they enable further aspects of the tensions within popular representations of science to be elaborated and explored.

One further dimension of this also involves Richards and his role in the origin of the Fantastic Four. The Four were exposed to cosmic rays because they took a test flight in Richards' experimental "star ship" (so does that make Richards a mad scientist?). Richards' friend, test pilot Ben Grimm, became transformed into the ugly, monstrous Thing and he blames Richards for his tragic condition. Grimm comes from an impoverished background in Manhattan's Lower East Side, whereas Richards is the son of a wealthy scientist-inventor and the archetypal college-boy. Thus, the two embody a series of oppositions: poverty/wealth; brawn/brain; ugly/handsome; manual/non-manual; alienation/involvement. In Richards, science appears as the purified "sacred" realm of Enlightened modernism; but Grimm reminds us of its "profane" by-product, the oppression of workers in a world constructed from industrial techno-science. This again provides opportunities for the tensions informing popular science to be explored—in this case its social exclusivity. Grimm and Richards are caught in a perpetual struggle over Richards' responsibility for his friend's condition, but for all his scientific genius he is powerless to help. Thus, in a variety

of ways, the social consequences of professional science—its “riskiness” and who tends to shoulder the burden of that risk—are symbolized and enacted.

5. Conclusion

Any attempt to understand popular representations of science must begin with a recognition of their complexity. For too long, academic thought has worked with overly simple formulas regarding the way science “affects” people. By looking more closely at what is itself often thought of as merely formulaic literature, I have sought to argue that two such formulas—disenchantment and enchantment—do not capture enough of the complexity discernible in representations of science in super-hero comics. These representations bear the full range of characteristics that might be associated with disenchanted and enchanted images of science. Thus, science is commonly treated as one means to attain an enchanted condition that brings contact with a transcendent cosmological order in which all ways of knowing and being are accorded their place. This cosmological order is itself given personalized form in various “cosmic” entities whose enchanted condition may itself be a result of science, or a representation of a scientific worldview. In this way, science appears as something sacred and extra-ordinary, as more than human—but also as a means of entering into or attaining contact with this overarching order. Science in this respect then is like magic, but also like magic it is not an unalloyed good, or an unqualified power simply to be accepted. Rather, science in this condition may also be a source of alienation, and thus of disenchantment, as it displaces any sense of value in the mundane human world with an attitude of cosmic indifference.

A similar complex applies to technology. Technology may be represented as a means of attaining contact with the sacred cosmological order, whether through using it to attain super-status, or to undertake a journey to an enchanted realm, or, as a *machina ex deus* to bring a story to resolution. However, technology is also a source of trouble, of worries over the possible loss of humanity, of where the boundary between humans and machines resides, and of what should be the proper place of machines in society.

The same contrasts reappear in the figure of the scientist. The scientist may equally be the savior-hero, bringing succor through his or her techno-magical intervention to set the world to rights, or the mad villain attempting to use techno-magic to turn the world upside down. But neither of these characters is unequivocal. The savior-scientist is just as likely to bring harm as the mad scientist is to be undone by factors beyond the capacities of science to control. Hence, in the clash of hero and villain, science while it invariably plays a pivotal role does so in contrasting and ambivalent ways. Science and the scientist are never simply one thing (at least, not in the wider scheme of continuity), but multiple, mixed, and moveable.

On the basis of this analysis, science neither simply disenchant nor enchants. Rather, these are two alternative ways of thinking about science that have common currency in our society. That point is very important: these are ways of *thinking about* science—this is as true of the world of popular culture as it is of the academic world. It is an error to assume that these two worlds are so divorced from each other; rather, this itself is one of the questions that troubles *both* (the same) worlds. Our means of representation and self-understanding—our cultural resources—are the same, even if we are divided by the language we share. Super-hero comics incorporate the same tensions that inform academic discussions and as such they should be seen as just as much a part of the collective working

out of the questions and problems raised by modern science. This working out involves us all; in this, we are all the experts.

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Notes

- 1 Comic-book sales have fluctuated considerably over the years, not least over the past decade or so—compare sales figures cited in Tanel and Murphy (1998), and Oehlert (1995), with the discussion in Workman (1997).
- 2 Some discussion of the use of hyperbole in describing the “miracles” of the natural world in religious fundamentalist discourse can be found in Locke (1999).
- 3 Gresh and Weinberg (2002), however, liken the Hulk to Frankenstein. This illustrates the point that the meaning of representations of science is mixed and multiple.
- 4 Here, I do wish to dispute an alternative reading given by Nelkin and Lindee (1995). Commenting on comic books based on ideas about genetics, they state that the “message” of *The X-Men* is “shared DNA is the essential characteristic defining humanness and justifying rights and respect. In the futuristic world of the X-Men, mutant humans with dorsal fins and telekinetic powers are the social equivalent of African Americans, Jews, Asians and other minority groups. Their creator, Dr. Xavier, pleads with the public to accept the ‘muties’, for ‘we are related, we are all family’” (p. 46). There are some errors of detail—it is “Professor” not “Dr.” Xavier; he is not the “creator” of the X-Men, but their teacher and mentor; he would never use the abusive term “mutie” except to reject it; and not all mutants have “dorsal fins” nor telekinetic powers as each has different physical attributes and powers—apart from these errors (popular science does not have a monopoly on inaccuracy it seems!), it is of course highly questionable that something as complex as a comic book series that has been published regularly since 1963 can be characterized as having a single uniform “message.” Moreover, what that “message” may be is open to the quite contrasting reading of an exploration of the question of whether humanness transcends genes. Xavier and his students stand precisely for the view that humanness is *not* genetically given—hence “we are all family”; *Homo sapiens* and *Homo superior* are essentially the same *despite genetic differences*—and they oppose “evil” mutants who take the opposite view. Genetic essentialism, therefore, is the position called into question. The series, then, articulates ambivalence about genetics, a subtlety missed by Nelkin and Lindee.
- 5 The change in origin in the recent Spider-Man film to a bite from a “genetically-engineered” spider is indicative of the prevalence of “gene talk” (Howe and Lyne, 1992; cf. Nelkin and Lindee, 1995; van Dijk, 1998) in contemporary popular science displacing radiation as the basis of plausibility in the motif of scientifically generated transformation.
- 6 Again, this may have had more plausibility at the time. Jack Kirby, co-creator of the Fantastic Four, is quoted as having said: “I got the idea about the cosmic rays after reading about the space program . . . They were worried about what effect the Van Allen Belt radiation might have on astronauts. It turns out that the radiation was easily shielded, but it had everybody worried for a while” (Wyman Jr, 1992: 124).
- 7 The point is somewhat different, however, as Haynes suggests a development of stereotypes of scientists, a view that gains some support from Tudor (1989) and Lambourne et al. (1990), but contrasts with Goldman (1989) and Skal (1998). My point is that, regardless of whether or not it is possible to trace a specific line of development, the material out of which types of scientists are constructed constitutes a set of ambivalent resources, which may well have been added to over time, although this does not mean older materials have been altogether abandoned.

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