and exclusion. Yet most observers of US higher education know of the élite nature and history of the big three and their role in educating the nation's rulers, past and present. The book is in part built on the shoulders of previous scholarly works, notably Marcia Graham Synnott's *The Half-Opened Door* (Greenwood, 1979) and Harold Wechsler's *The Qualified Student* (John Wiley, 1977).

What Karabel adds is an immersion into archival sources that allows him more fully to illuminate the voices of those who either set discriminatory admissions policies or struggled to change them. As Karabel observes, much has changed over the past forty or so years. The big three couldn't simply maintain their old allegiances and remain viable. Eventually, their leaders and influential alumni came to understand that greater inclusion meant they could play a larger role in society. They wanted their institutions to be more democratic and their students more academically talented.

In parallel with other universities, both public and private, Harvard, Princeton and Yale altered their admissions process to take more scholastically brilliant children from the middle and upper-middle classes. More important, they adopted affirmative-action policies to boost the number of minority students, initially focusing mainly on African-Americans.

There has, then, been a marked change for the better. The big three and a handful of other highly selective private institutions now educate a growing number of high-achieving minorities, some from lower-income backgrounds. Of the big three, Harvard has the highest percentage of undergraduates from ethnic minorities, about 28%. As in many other highly selective institutions, Asian-Americans are by far the largest minority group; African-Americans represent just 6.5%.

Some other things have not changed quite so much. Most minority students are from high-income families. Students from low-income families still go largely to public universities and colleges. Students from wealthy families still congregate at the most prestigious private institutions. Indeed, there is evidence that this trend is accelerating, reflecting, to some degree, the growing chasm between the rich and poor in the United States.

As Karabel notes, the big three are among the least diverse of the leading universities in terms of economic class. One reason is that admissions policies still favour the children of alumni. In 2002, 40% of such 'legacies' who applied to Harvard were admitted, compared with just 11% of all other applicants — a "birthright out of eighteenth-century British aristocracy, not twenty-first-century American democracy", one critic complained.

A limited supply of high-quality, prestigious, selective and increasingly wealthy private institutions, accompanied by growing demand both domestically and internationally, means the big three and their brethren will remain élite and powerful. What is largely missing in Karabel's and other examinations of the big three is a parallel story: the rise of the public university movement in the United States and its huge impact on socio-economic mobility. The scale of that enterprise dwarfs that of the big three and other private universities. Arguably, the viability and fate of public universities will have a greater effect on the nation's democratic experiment and global competitiveness. But the star power and academic achievements of the big three continue to draw the most attention, obscuring this reality. ■

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Cultural reflections

Hubris and Hybrids: A Cultural History of Technology and Science
by Mikael Hård & Andrew Jamison
Routledge: 2005. 335 pp. $90 (hbk); $29.95 (pbk)

Howard P. Segal

It is a truism that culture, broadly defined, shapes science and technology as much as they shape culture. This once controversial position became the conventional wisdom decades ago, after purely internal histories of science and technology, followed by largely uncritical interpretations of their developments, were displaced as the dominant models.

In their excellent book *Hubris and Hybrids*, historians Mikael Hård and Andrew Jamison engage in a cultural assessment of science and technology. They replace the traditional 'heroic tale' of scientific genius with stories of the frequently mixed blessings of science and technology.

The 'hubris' of the title is reflected in James Watson's book *The Double Helix* (Atheneum, 1968), which recounts the race to discover the structure of DNA. In Watson's book the professional and monetary rewards were seen virtually as ends in themselves; there was a role for intuition along with conventional scientific methods; there was questionable treatment of peers; and there was little concern for the social and moral consequences of research. For Watson, limits to either human intelligence or human power over nature had virtually disappeared. Yet Watson never denied his own flaws, and so helped to push scientific heroes off their traditional pedestals.

But even this account is too 'romantic' for Hård and Jamison, who seek even franker explorations of science from inside the laboratory — but only if paired with external (yet no less frank) analyses, such as Vandana Shiva's *Stolen Harvest* (South End, 2000). 'Hybrids' is the implicit theme of Shiva's book, which describes the way large corporations use the biotechnology derived from the genetic code. Some of these enterprises make huge profits while exploiting poor farmers, harming the environment, and undermining traditional balances between mankind and nature.

Hård and Jamison describe this story as a "tragedy" but wisely go beyond merely stressing the victimization. They never reduce their stories to wholesale good versus evil. Instead they focus on the growing convergence between science and technology into 'techno-science'. This is not simply about the elimination of most of the remaining barriers between scientific discovery and technological applications. It is also the story of changing meanings of being human, as we incorporate ever more technology within ourselves and our immediate surroundings. The authors discuss the possible cloning of people in the future, as well

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FOX, ANNE MARIE/CORBIS SYGMA

Frankenstein (Kenneth Branagh, left) refused to take responsibility for his creation (Robert De Niro).

as current issues such as the implantation of mechanical devices, the increased consumption of genetically engineered foods, a growing reliance on mobile phones and the Internet for daily communication, and endless modifications of the natural environment.

The authors invoke the influential concept of 'cyborgs': beings that are like humans in their ability to learn, feel and experience consciousness, but also like machines in having been 'programmed' to learn, feel and experience the world in only particular forms. Hence the authors' proper use of 'hybrids', a term they creatively apply to various contexts.

Hård and Jamison also provide useful summaries of the writings of earlier scholars, including Lewis Mumford, Siegfried Giedion, Lynn White and Raymond Williams, who all provided ground-breaking studies of science and technology in broad historical and cultural contexts, and Thomas Kuhn and Michel Foucault, who offered penetrating critiques of science and technology as being to varying degrees socially constructed. Hård and Jamison revisit, update and sometimes revise these earlier studies. By contrast, they criticize the founding editors of the leading journals of the history of science (George Sarton) and of the history of technology (Melvin Kranzberg) for promoting traditional uncritical views. Sarton's journal *Isis* may once have been guilty as charged, but Kranzberg's *Technology and Culture* was never so one-sided.

Far from being a critique of the excesses of only modern science and technology, *Hubris and Hybrids* is an extremely wide-ranging historical survey. Its coverage begins with the Scientific Revolution, Britain's Industrial Revolution, and the Enlightenment. More modern topics include technocracy movements, artistic uses of science and technology from William Morris to the film *The Matrix*, appropriate technology, the greening of corporate America and Europe, film and industrial design, and Asian developments. The richness of the authors' observations on these historical phenomena is exemplified by their comments on the medieval period: "eyeglasses and mirrors created opportunities to experience a technically mediated reality".

The authors hardly claim expertise in every area they discuss, but even so I was disappointed by their simplified comments on Mary Shelley's *Frankenstein*. Not only do Hård and Jamison follow most other commentators in wrongly describing Victor Frankenstein's unnamed and quickly abandoned creature as a "monster", but they also follow the crowd in wrongly characterizing Victor as a "mad scientist". Except in appearance, the "creature" — as he is usually called until the novel's later stages — is repeatedly portrayed as more human and humane than his creator. In my view, this should have been connected with the authors' own emphasis on humanity's changing identities. As for Victor, he is quite sane but is extraordinarily self-centred, as indifferent towards his family and friends as he is to his creature. Ironically, his creature embodies Victor's missing moral compass.

Were Victor truly mad, he might well have escaped Shelley's actual target: his refusal to take responsibility for his research project. Here the authors missed the opportunity to use Frankenstein to bolster their own case. Neither work is a Luddite tract. Shelley argues that only if scientific experiments prove harmful to society should they be stopped. *Hubris and Hybrids* extends this same position to inventors and engineers.

Recognizing that the relationship between the past and the future is different for historians from that for scientists, inventors and engineers, Hård and Jamison wisely offer no simple historical lessons, much less any silly predictions. What they provide instead are provocative and perceptive reflections that deserve to reach a wide general audience. ■

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An inside view of the Universe

Theaters of Time and Space: American Planetaria, 1930–1970
by Jordan D. Marché II
Rutgers University Press: 2005. 266 pp. $49.95

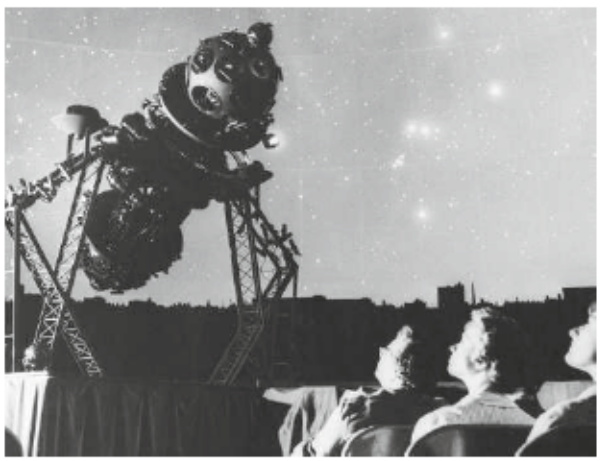
Shawn Cruzen

The spectacle of the night sky stretched overhead is the most breathtaking of natural wonders. Throughout time, people from every culture and from every part of the globe have experienced a sense of the infinite when confronted with the canopy of the Universe in a genuinely dark sky. However, the progression towards a more urbanized, industrialized society has brought with it a shroud of light pollution that has hidden this view from roughly half of Earth's population. But many city dwellers, especially in the United States, can still enjoy the splendour of a starry sky — by visiting their local planetarium, an island of sparkling celestial clarity (albeit artificial) in a sea of perpetual urban twilight.

In *Theaters of Time and Space*, author, science historian and planetarium veteran Jordan D. Marché II explores the evolution of planetaria from their inception in Germany to their proliferation across the United States. This account is both meticulous and colourful, and is sure to be enjoyed by anyone who is interested in astronomy, loves mechanical devices or has simply found inspiration under a planetarium's virtual starlight. The book outlines many of the social and cultural influences that fostered the spread of planetaria and their growth in popularity.

The concept of the planetarium was born from a confluence of ideas and technologies, including two early mechanical models of the Universe. The first of these, the orrery, uses a system of gears and wheels to demonstrate the motions of the Sun, Moon and planets. The second was a hollow rotating globe, large enough to hold a small audience, with the stars and constellations painted on the interior to demonstrate celestial motions. With impetus from Oskar von Miller of the Deutsches Museum in Munich, an engineer named Walther Bauersfeld of the venerable Carl Zeiss optical company hit upon the idea of using projected images to show the motions of bodies in the Solar System against a fixed dome of painted stars. His colleague Werner Straubel then suggested optically projecting the stars as well. This engineering epiphany led to the genesis of the modern projection planetarium.

The Carl Zeiss company made the first planetarium for the Deutsches Museum on the roof of its own factory in Jena, Germany.



ADLER PLANETARIUM

Star attraction: Zeiss projectors in the Adler Planetarium have given the Chicago public a glimpse of the heavens since 1930.

It opened in August 1923, and its abilities were demonstrated in the factory for a year before it was installed in the Munich museum the following August.

Marché chronicles the arrival of Zeiss planetaria in five major US cities between 1930 and 1939. Chicago's Adler Planetarium, featuring the Zeiss Model II projector, was the first, but others soon opened to enthusiastic audiences in Philadelphia, Los Angeles, New York and Pittsburgh.

Although Zeiss dominated early on, several imaginative inventors soon offered creative