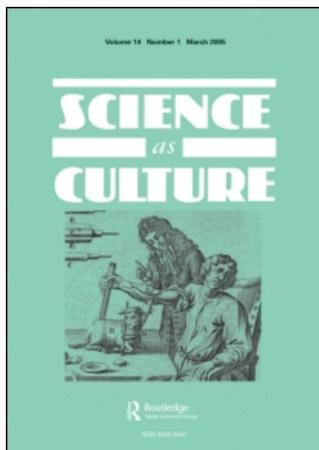


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Access Details: [subscription number 768420433]
Publisher: Routledge
Informa Ltd Registered in England and Wales Registered Number: 1072954
Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Science as Culture

Publication details, including instructions for authors and subscription information:
<http://www.informaworld.com/smpp/title~content=t713444970>

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Online Publication Date: 01 December 2003

To cite this Article: Frank, Scott (2003) 'REEL REALITY: Science Consultants in Hollywood', Science as Culture, 12:4, 427 - 469

To link to this article: DOI: 10.1080/0950543032000150319

URL: <http://dx.doi.org/10.1080/0950543032000150319>

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REEL REALITY: Science Consultants in Hollywood

SCOTT FRANK

Carl Sagan would have been proud of the film's scientific accuracy if he had lived to see the film through to its conclusion ... (Dennis Schwartz writing on *Contact* in *Ozus' World Movie Reviews*).

Find me a scientist! A geologist! Someone who can tell me what the hell is going on! [Mike Roark (Tommy Lee Jones) in *Volcano*].

Surprisingly enough, when Tommy Lee Jones shouts out this line during the eruption of Mt. Wilshire in *Volcano*, he actually echoes the cries of some of the most powerful people in Hollywood. Twenty per cent of the top grossing films of all time have had scientific or technical consultants,¹ as did the 2000 and 2001 Best Picture Oscar winners (*Gladiator* and *A Beautiful Mind*), several of the top-rated television shows of recent years (*C.S.I.: Crime Scene Investigation* and *The X-Files* among them), and a prodigious number of other entertainment industry products.

This is a paper about the experience of science consultants in Hollywood. It examines the process through which their input is secured and incorporated by filmmakers, and how that knowledge is part of a process of commodification of scientific knowledge through which those filmmakers play with the concept of reality as part of the industry and craft of the dream factory. It interrogates the idea of reality as viewed through native eyes: as social scientists, when the producer of the movie *Spider-Man* says during an interview that his movie is very accurate scientifically, our duty is not to stare back at him in disbelief, but to take that sentiment and try to understand the cultural framework that enables him not just to say this with a straight face, but to mean it.

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Science consultants are liminal figures in the entertainment industry—on the production team but not of it, outsiders who are brought inside for a brief moment. Analysing their experiences provides us with a window into an important arena in which images of science, scientists, and technology are produced for public consumption. It is no stretch to say that more people have seen scientists on TV or in films than know one personally, and that a greater population has seen *Jurassic Park* than have ever taken a palaeontology class.

Interviewing science consultants is a way to answer some basic, but very important, questions about the treatment of science in Hollywood today.² These include:

- How does the input of the consultants reconcile the Hollywood concept of ‘reality’ with the science that ends up on screen?
- Why are consultants hired and how does their presence affect the final product?
- How do outsiders interact with members of the relatively closed world of entertainment industry production?

Answering these questions will grant us a deeper insight into the process through which science is incorporated into mass entertainment media, the way in which scientific knowledge is commodified and utilized in the (modern) studio system, and the image of science and scientists that ends up on screen. Consultants provide two major services to entertainment industry productions: (1) they furnish the cues that allow filmmakers to give the fictional images and situations on screen a greater sense of perceptual reality; and (2) through the social force of symbolic capital they are presumed to possess, both enable the filmmakers to feel better about the products they create and become part of the studio publicity machine that tries to impress upon us, the viewing public, that their production partakes of the Real.

The motivations of those who employ consultants, the experiences of those consultants, and the relationship of their scientific knowledge to other studio concerns like budget and filming time tell us about the place of scientific knowledge in Hollywood—how it is treated, if it is respected, and its assigned importance in the litany of ingredients that make up a mass media production.

■ REALITY IN HOLLYWOOD

Talking about 'reality' in Hollywood is a difficult task, and involves trying to impose logic on a subculture where reason does not always appear to have the firmest grip. In the entertainment industry, ambiguity and polysemic readings of the term 'reality' are unavoidable, semantic consistency seemingly absent, and studio budgets, 'artistic sensibility' and poetic license are the only final arbiters. Inhabitants of the studios use the term 'reality' with reckless abandon. Informants employ phrases such as 'getting it right' and 'scientifically credible' without ever specifying what 'it' is or defining 'scientifically'. The list of frequently used terms in a Hollywood production include not just 'real' and 'reality' but 'veracity', 'credibility', and 'verisimilitude'. When Steven Spielberg says of *Jurassic Park* 'This isn't science fiction, it's science eventuality' (*Jurassic Park* press kit, 1993, p. 1), at least we can all grasp that there is some tenuous relationship between the story and actual genetic and palaeontological knowledge. But when the press kit for the vampire movie *Blade II* suggests that '[Director] del Toro's mandate was to realistically blend both the comic-book nature of the movie into the visual effects' (2002, p. 34) or the director of *Reign of Fire* says with a straight face 'the goal is that you'll never notice that the dragons are fake' (Hillner, 2002, p. 70), the mind begins to reel. How can there be a 'realistic' vampire? And given that dragons don't exist, wouldn't the audience naturally know that the ones they see on screen are fake?

We can explain this seeming incongruity, and understand exactly what science consultants bring to a production and why they are recruited to do so, within the analytical framework provided by the concept of 'perceptual reality'. Stephen Prince suggests that in visual media, there are two standards of reality that can be used to describe any filmed image, and which characterize the audience's relationship to that image (1996, p. 32). These standards, which he terms the referential and the perceptual, acknowledge four states to describe an image. Thus a scene in a film is 'referentially' either real or unreal—that is, it depicts events that actually occur or exist, or ones that are imagined. The same scene is also either 'perceptually' real or unreal, meaning that it appears to be real or appears to be a fantasy (or lack significant real-world elements).

To become perceptually real means depending on references

between what people know to be true from outside, real-life experiences, and what they see on screen. If the relationship to experiential cues is strong enough, a film can make things *appear* perceptually real. So if a movie like *Jurassic Park* (or even *Blade II*) plays its cards right, 'unreal images can be referentially fictional but perceptually realistic' (Prince, 1996, p. 32). Thus the animators who programmed in the dinosaurs for Spielberg went as far as possible to include familiar visual cues in the dinosaur's appearance and movement: textures for the skin mimicking modern lizards, and computer models that made certain they grouped like real-world pack animals as they ran. Even if individual audience members had little or no experience with live animals, they had almost certainly seen how they act or look in 'real' life through television news and documentaries or at the local zoo.

The drive for perceptual reality goes beyond visual appearance and includes the basic plotlines and background of a story. In Hollywood, it is not considered enough that the spaceships or tornadoes look real; an audience must be led to believe that referentially unreal situations, discoveries, or people could be real as well. Steven Spielberg said '*Jurassic Park* would not be *Jurassic Park* had it not been for the wholly credible aspect of cloning from DNA' (Kennedy, 2002, p. 112). Even in cases where the scientific basis for a film is fairly tangential, filmmakers believe in this aspect of their work: Avi Arad, who produced *Spider-Man*, *X-Men*, and *The Incredible Hulk* said

All these things have scientific explanations. That makes it; I think it makes it more interesting for the audience ... It's the fact that if it can happen, and we can show the viewers that it's not—we are not asking you to make a blind leap of faith, but a leap of faith nevertheless, that is backed by enough information that it makes sense, and when you see the *Hulk* movie, you will look at it and say 'you know, this is not that outlandish'.

One hesitates to imagine a situation in which *The Incredible Hulk* does not seem outlandish, and that of course is the point. The job of a science consultant is to help make things that are referentially unreal (dragons, fake volcanoes, incredible hulks) into objects and situations that seem *perceptually* real. They do this by building up a

series of suggestions referencing what we know is real, or think we know, and what we see on screen. These include both visual cues, like the colour of the surface of Mars, or the size of dinosaurs, and those concerned with the basic scientific principles referenced by the films and television programmes—cloning, space travel, radiation, etc. To do this takes a tremendous amount of time and energy on behalf of everyone involved in the production; the specifics of how consultants contribute to this effort are treated in-depth later in the paper.

The question of why a notoriously cost-conscious industry would bother with something as ephemeral as perceptual reality will be addressed momentarily, but part of it has to do with the idea that a certain level of reality is required for audiences to feel connected with a film or television programme. Shanahan and Morgan call this 'presumed realism' (1999, p. 22). They posit that there is a background level of realism that audiences infer will be present even in a fictional work—that *ER* is what a hospital looks like, or *NYPD Blue* a police station. Viewers usually gloss over background details as they watch (even if filmmakers do not) as long as that background matches expectations. A film showing a volcano which erupted with lava that was bright purple instead of the expected glowing orange would seem very strange, or a laboratory with no test tubes or beeping scientific-looking machines.

This requirement for a sort of basic foundation in familiar reality or expectation extends both to the visual environment of a film or television programme and to the plot. People involved in the production of these media products believe that audiences will not be drawn to images that appear even subtly false. As one publicist told me, 'the audience today is very sophisticated, and they like to go see a picture that is believable'. A producer, talking about a scene in a famous film that drew upon a consultant's input, said 'I think it subliminally lends credibility, even if people stood back and say "well, that's ridiculous, and that wouldn't happen". It lent a credibility to the idea'. The stated belief is that at the very least, audiences need a plausible scientific-sounding excuse: cloning and mosquitoes trapped in amber in order to bring dinosaurs to life, radiation to create a hulk or spider-man.

Another useful set of terms for discussing the inclusion of science in the entertainment media are the twin concepts of 'veritable' and

'dramatic' truth. Originally used by screenwriter James McGuinness in a letter sent to Louis B. Mayer during the 1946 filming of *The Beginning or the End*, these terms were cunningly appropriated by Nathan Rheingold in his discussion of that film. McGuinness wrote 'it must be realized that dramatic truth is just as compelling a requirement on us as veritable truth is on a scientist' (Rheingold, 1985, p. 232). If veritable truth is that revealed by real scientists, dramatic truth is the version of that truth that is entertaining and commercially viable—in other words, the veritable truth that appears on screen once it is filtered through the social and structural limitations imposed upon it by the filming process. These limitations can include everything from studios' time and budgetary constraints to personal preferences of the director or the filmic requirement to keep things visually appealing.

The contested nature of scientific knowledge makes it difficult for us to uncritically accept the concept of scientifically veritable truth, but to McGuinness, the native informant, it could perhaps best be defined as generally accepted scientific knowledge, and science as practised in the way scientists themselves believed it to be. So veritable truth consists of long periods of experimentation, the speed of light as a limit on physical velocity, that the surface of Mars is red, and public academic discourses; dramatic truth is evolution occurring on screen in a matter of minutes, antigravity fields, and eureka moments in which single scientific discoveries save entire galaxies. The distinction is illustrated in this exchange between a consultant and his director, related by the consultant:

[The director] said 'hey, could you drive a car across molten lava? You know, with a thin crust on it?' And I said 'well ... no' ... I said 'look, people—look, you can pull the scene, you can drive across the lava, but you've got six seconds—that car will explode ... the temperatures, 2000 degree Fahrenheit, they're so hot, you can't imagine' ... the point is, that close to a lava flow, you'll burn your hairs! From the radiant energy. So that stuff went through. But, you know, we objected to that, but [the lead actor] said 'hey, Jack, you know—that particular scene, that's gonna be a good one' and he says 'I know we're stretching it in terms of time, but hey,

we've got to fill some of these words—we gotta sell, remember our job, we gotta sell some popcorn!

When members of a production staff speak of 'getting it right', they generally seem to be addressing a willingness to incorporate veritable truth into their work. The 'it' referred to references their notion of some sort of external universal scientific fact, and by getting it right they are attempting to cause aspects of their production (plotline, characterization, dialogue, or visuals) to adhere closely to that universal scientific truth.

Prince and Rheingold's terms complement each other by each referring to different aspects of the question at hand. Perceptual and referential reality describe *why* science consultants are hired, and provide a theoretical model for explaining why science is incorporated by Hollywood, in a manner illustrated later in the paper. Veritable and dramatic truth address how informants—scientists, science consultants, and insiders from the entertainment industry—seem to envision scientific knowledge and understanding when speaking with each other and to outsiders (i.e. anthropologists).

The concept of filmed reality is of primary importance to this discussion; science consultants are part of a movement by studios, directors, producers, and others within the entertainment industry to convince us that what they are putting on screen is real. The value of science consultants to a production is based on reality: on their closeness to it, their ability to bring it into a production, and the ability of the studio to make use of the perceived gravitas their relation to it brings.

In describing the 'pre-capitalist' economic system of the Kabyles people of Algeria, Pierre Bourdieu proposed the idea of 'symbolic capital' as a concept with an essential connection to 'real' capital. Especially in difficult, complex, or extremely high-value transactions like marriage (or film production), Kabyles 'bring in prestigious kinsmen or affines are "guarantors"' (Bourdieu, 1994, p. 170). Having these high-prestige kinsmen—the symbolic capital here being their honour or renown—is a sort of credit, guaranteeing a certain return and adding to the attractiveness of making a deal (Bourdieu, 1994, p. 175). In the entertainment industry, science consultants possess this symbolic capital, and producers and directors court it.

The symbolic capital of consultants is based on their perceived relationship with scientific, veritable, reality, and their association with the prestige of science. It is this property the filmmakers are anxious to recruit.

■ CONSULTANTS, THEN AND NOW

The use of scientific and technical consultants in the entertainment industry is a long-standing practice. Advertisements in 1950 for *Destination Moon* proclaimed that it was 'produced under the supervision of Physicists, Engineers, Rocket Experts, and Astronomers'. A 1966 article in *Daily Variety* characterized the careful use of consultants by *Star Trek* creator Gene Roddenberry. Roddenberry apparently designed the starship *Enterprise* in conjunction with the Rand Corporation, and had the design reviewed by faculty at the California Institute of Technology.³ The show's weapon concepts were also reviewed by Rand, and when told laser guns would exist by the time the series aired, Roddenberry reported that 'we went back to physics, found a phaser gun that's 50 years away. That's what we're using' (Kaufman, 1966, p. 9). Anthropologists got in on this early action as well: in the personal papers of Margaret Mead at the Library of Congress sits an interview done of Mead by Stanley Kubrick's staff prior to the production of *2001: A Space Odyssey*. During the interview, they asked her about the possibility of intelligent life on other planets, the likelihood that it had anything to do with evolution here on Earth, and the likely worldwide reaction to first contact.

These are exceedingly rare cases, however; it is painfully clear that the vast majority of science fiction films and television shows of the last 90 years were not particularly concerned with scientific veracity. Seemingly more frequent was the use of technical advisors in historical films, with varying effects. The press kit for *Madame Curie* (1943), for example, bore on its back cover the statement 'fidelity to the scientific steps which led to the discovery of Radium was assured by Dr Rudolph M. Langer, California Institute of Technology physicist'. Other historical films that utilized technical consultants include *The Vikings* (1958), *The Last Supper* (1976), *A Bridge Too Far* (1977), *The Return of Martin Guerre* (1982), and more recently, *The Patriot* (2000) and *Gladiator* (2000).

In fact, Margaret Mead's experience may well be illustrative of the historical treatment of consultants. Throughout the interview between Mead and Kubrick's people, the interviewer continually asks questions related to the plot points of the film (as should be expected), but when Mead's answer doesn't match the mythology of the movie, he keeps pressing, attempting to lead her into uttering an appropriate sound bite. In the end, the content of the film directly contradicts Mead's responses on every subject. It shows aliens coming to Earth (which she denied there was evidence for), it shows their intercession sparking human evolution (which she disputed as a likely explanation), and it makes a big deal of the necessity of keeping knowledge of the alien artefact secret in the year 2001; both from the public, and it should be noted, from the scientists on the space mission sent to investigate it. This is the diametric response Mead gave in her interview, in which she promoted the transparency of scientific discovery as a virtue.⁴

Generally speaking, things are different today; consultants are still hired on a temporary basis, though the ones I spoke with occasionally rejected a fee, and were almost always heeded, with a level of input that surprised even them. In 1943, *Madame Curie's* consultant rated a small paragraph on the back of the press booklet, and Mead's contribution (if she made one) to *2001* is unrecorded in the film's credits. Today, consultants are not just brought on board to answer questions of scientific veracity, but have become an important part of selling the picture. As part of the studio's move to market 'reality', they are drawn into the carefully choreographed publicity machine of the studios: one reported doing full-time duty on a press junket alongside the film's stars, and several remarked that they had been interviewed by CNN.

The number of recent Hollywood products which have 'benefited' from consultants' input is long: three *Jurassic Park* films (1993, 1997 and 2001), *Twister* (1996), *Dante's Peak* (1997), *Volcano* (1997), *Gattaca* (1997), *Armageddon* (1998), *Deep Impact* (1998), *The X-Files* (1998), *Mission to Mars* (2000), *Red Planet* (2000), *Spider-Man* (2002), *The Core* (2003), and the *Star Trek* television programmes, among others. Only the most casually fantastic science fiction films, like *Men In Black II* or the *Star Wars* movies, feel safe ignoring their input entirely.

□ *Avatars of science: who and why consultants are*

This research involved 14 consultants, 10 of whom worked on fictional or entertainment-oriented products, and five on educational programmes. The consultants interviewed worked on a total of 20 projects, 17 of them Hollywood entertainment productions. The remaining three were documentaries or educational programmes.⁵ These ranged from minor television movies to major network television shows and some of the most widely-viewed films ever made; the combined viewership of the projects these consultants were involved with easily reaches into the billions. Also included is the brief participant observer experience I had working as the archaeological consultant for an (ultimately unproduced) cable television programme. Other personnel interviewed over the course of this project included publicists, studio research librarians, and producers—once again, some of whom are credited with a number of the biggest box office successes of all time.⁶

There are three demographic generalizations that can be made about the group of consultants. The first is they are mostly male; only two of the 10 Hollywood consultants were female. This gender ratio is actually fairly representative of the US science and engineering workforce; National Science Foundation statistics show that women make up 23% of the science labour pool (NSF, 2000, p. 3–2).⁷ Second, all of the consultants were white. This reflects the ethnic makeup of the entertainment industry more than that of the science workforce, which is composed of 17% ethnic minorities (NSF, 2000, p. 3–12). The third general characteristic is that they are all well-regarded professionals of one kind or another. The consultants range from people at the top of their field to those with only a few years of working experience. They are federal employees (four), university professors (seven), private consultants (two), and one entertainment industry professional; the group includes the editor of a respected journal, a museum curator, and a Nobel prize winner. Their range of professional experience is amazing: one has cooked his dinner over lava; another steered Apollo astronauts on their course from the Johnson Space Center in Houston; a third is the creator of the ‘DNA computer’ and the man who coined the term ‘computer virus’. All of them cared deeply for their work, and the pursuit of science, and almost all of them had an overwhelmingly pleasurable experience working on the set, often to their own surprise.

Why talk to scientific and technical consultants? What can a consultant tell us about moviemaking that, say, the director, or even the cameraman for that matter, cannot? In the first place, often the consultant serves as the basis for characters in the production for which they are advising. For instance, palaeontologist Jack Horner was the 'inspiration' for Dr Alan Grant, the main protagonist of *Jurassic Park*, a link that the studio exploited. Prior to release, Universal Pictures had sent a series of fake 'press releases' out, simulating a publicity drive leading up to the opening of the theme park from the film. In one issue of this *Jurassic News* Grant is described as being 'responsible for a series of extraordinary finds that have enabled laymen to view the mysterious dinosaur as a real animal' (1993, p. 1). This neatly mimics a description of Horner from *Time* magazine (quoted in the actual *Jurassic Park* [the film's] press kit): 'Horner's ideas on this subject, based on a series of extraordinary finds, have helped rescue dinosaurs from the abstract realm of monsters, enabling them to be seen as real animals' (1993, p. 42).

Similarly, Jodie Foster's character in *Contact* (Dr Ellie Arroway) was allegedly a combination of her creator, Carl Sagan, and astronomer Jill Tarter (Davidson, 1999, p. 349; Millar, 2000, p. 74). Like Sagan, Arroway was a fervent believer in life beyond earth; like Tarter, she is the female lead of the SETI programme and struggled to keep the project alive after the government cut its funding. Information from the *Twister* press kit and suggestions by consultants indicate that the film's 'Storm Chasers' are modelled after the real ones in the VORTEX (Verification of the Origins of Rotation in Tornadoes Experiment) project at the National Severe Storms Laboratory. Even when characters aren't based directly upon the personality or achievements of specific consultants, the very nature of a consultant's work means that scientists appearing on screen are to some extent their progeny—characters whose actions and knowledge are based on the consultants' input, and informed by the filmmakers' experiences talking and working with them.

More importantly, the consultants have an impact (of varying degree) on how science, scientists, and situations involving science and scientists are portrayed. Scientific and technical consultants have had a decisive input into everything from how movies show the pursuit of experimental science to the colour of lava and the hero's



Contact's Ellie Arroway (Jodie Foster) is the on-screen progeny of three scientists and consultants. Carl Sagan created the character, with astronomer Jill Tarter as his template. While during the production, Foster herself, with an eye toward authenticating the character, secured the input of former NASA employee Gerry Griffin.

Credit: *Contact* (Warner Brothers, 1997).

scientific technobabble. Because of the nature of their job, consultants are closer to the production than any other outsider can be, but they are always wearing two hats: one as a member of the production staff, and the second as a professional scientist. Science consultants are the mediators between dramatic and veritable truth.

They, more than anyone else, have an informed perspective on the inclusion of science in films, and the way 'real' science is manipulated to fit into them. Consultants arguably possess the greatest understanding of exactly how much real science is in a film or television show, what got put in, and what got left out. Aside from perhaps anyone except the director, science consultants have an understanding of the decision process that led to the treatment of science and scientists as it finally appears on screen. Furthermore, as liminal figures on a set, they can view the process of filmmaking as

an inside outsider, much as an anthropologist would. Informants noted that their prestige and position granted access to the upper echelon of the production staff; while their outsider status put them in the unique position of knowing that they are not beholden to those individuals for their future career success.

That prestige derives from the presumed intelligence and education of the consultants (possibly in comparison with the stereotype of Hollywood denizens as shallow and base) and particularly as those qualities reflect their close relationship to reality—which is to say ‘authentic’, as opposed to cinematic, science (or veritable, as opposed to dramatic, truth). Bourdieu suggests that ‘economic and symbolic capital are so inextricably intertwined that the display of material and symbolic strength represented by prestigious affines is in itself likely to bring in material profits’ (Bourdieu, 1990, p. 119). This may be reflected in the stated reasons producers and directors hire consultants; while there is no doubt that many sincerely do care about veracity in their films and television programmes, the belief that real science in a production can bring in real capital clearly accounts for the consultants’ participation in some features.

This may be especially true of films like *Volcano*, where the producer states that ‘we hope to present the true *experience* of a volcanic eruption—something that’s never been done before in a studio film. We want audiences to believe that they’re seeing the real thing’ (*Volcano* press kit, 1997, p. 4), while a scientist informant dismisses the science in the movie as ‘a joke’ and labels the picture ‘a schlock film’. Science consultants are, in a sense, avatars of the fetishization of science by the entertainment industry. That is, they personify the cachet, knowledge, and box-office possibility of ‘real’ science that filmmakers strive to embrace.

■ SLOW AND EXPENSIVE: WHY THEY ARE HIRED

During one episode of *The X-Files*, Hollywood comes knocking on the FBI’s door to make a movie version of the exploits of Agents Mulder and Scully. The screenwriter tells the agents that he might take creative liberties with the material: ‘After all’, he says, ‘fiction is quicker than truth and cheaper’.

Given this statement, why *are* consultants hired? Doing what people in the entertainment industry call ‘getting it right’—bringing

a high level of perceptual reality to a production, and basing it on 'real' science—is indeed more expensive and time-consuming than simply allowing things to remain perceptually as well as referentially unreal. For example, say a producer claims he wants to make his volcano movie 'real'. Even keeping in mind the casual use of the concept of reality in Hollywood, in order to do this, he'll need to have someone do the research on volcanoes, eruptions, and related material at the studio research library, hire a consultant, wait for the consultant's advice, and make changes based on that advice. Members of the production staff will then have to build the sets and special effects as realistically as possible based on the library research and consultant input, and perhaps even make plot changes to reflect the scientific verisimilitude.

If, on the other hand, our mythical producer doesn't care, he can have the set crew slap together whatever looks closest to what they think a volcano looks like, toss in some pyrotechnics, paint it red, and go with that.⁸ As Joel Black suggests, 'ever more talent and resources are devoted to making artifice seem natural, the nonvisible appear visible, and the realm of the imaginary come across as convincing or credible' (2002, p. 10). Yet despite their cost in time and money, consultants are seemingly considered more and more critical to a production. The motives, as with so many things in Hollywood, involve both art and commerce.

Consultants are brought in for a number of reasons. Consultants and other entertainment industry informants state those reasons as falling into the following broad categories:

- Scientific realism is an artistic goal of the producer/director (personal artistic reasons).
- The director/producer is a perfectionist and considers verisimilitude part of that perfectionism (professional artistic reasons).
- The actors care (from similar motivations as the directors/producers).
- Audiences prefer it—or more specifically, there is a general belief in the industry that moviegoers care, and indicate that preference at the box office.

In the section that follows, consultants' relationships with producers, directors, and actors will be detailed, and an explanation will be

made of how the personal vision of certain members of the production staff delineates the influence a consultant has on a set.

However, it must be kept in mind that a variety of factors outside the desires of the filmmakers also impact the amount of input a consultant has. The Golden Rule states that whoever has the gold makes the rules, and it is studio executives who hold the purse-strings. For both immediate financial reasons (lower costs mean higher profits) and marketing ones (the belief that the first film released on a given topic will make more money), the desires of the filmmakers are often curtailed. A consultant related how competition affected the production and scientific content of *Dante's Peak*, which became rushed when a competing studio decided to release a similar movie:

Their problem was, they were in this war with [20th Century] Fox, and Fox had *Volcano* coming out, and *Dante's Peak* had to be first. Because if the schlock film came out, if *Volcano* came out first, *Dante's Peak* would be buried! ... *Volcano* was originally a summer film, and so *Dante's Peak* they decided to release in June ... so Fox just kept pushing *Volcano* up ... brilliant tactics—further and further, into the Spring ... And so we had some really good marketing plans that—we were going to go ahead and establish the film's veracity in an orderly fashion [in the publicity and marketing], and they fell by the wayside.

Within the Hollywood system, a few individuals are powerful enough to make their own rules, or at least bend them into a position more to their liking. These are the Steven Speilbergs, Mimi Leders, and Michael Crichtons of the industry—people whose ability to continually create popular works is so great that they have certain leeway to produce what they want. Coincidentally, a number of them are involved in the production of the genre of film that can best be termed the Science Blockbusters,⁹ and have shown an abiding interest in science and science-fiction themes. When speaking with science consultants, almost every one of them praised the personal desire of the filmmakers to 'get it right' scientifically, and these personal artistic desires clearly play an important role in the creation of these science-related films. The artistic sensibilities of powerful directors are definitely a factor—otherwise they would not put in

motion the process of hiring consultants. At the same time, the economic impetus behind Hollywood activities is an important factor. During one interview, a publicist said that:

Science and technology have become two of the most sought-after themes by movie producers. They're desperately looking for material with those subjects. Because right now, among ages 18–34, that's *the* top thing they're interested in.

Science and scientific knowledge are valuable to Hollywood, and when something is valued in a capitalist system, the people operating in that system will find a way to commodify it. That is, they'll make science into something they can recruit and use at will, and control to fit their needs and wants. We can begin to see the process through which this occurs by looking at who hires science consultants, and the experiences those consultants have with the people in the production system.

■ CONSULTANTS AND THEIR EMPLOYERS: 'GLUED TO MY HIP'

The consultants reported a wide variety of experiences regarding their initial introduction to Hollywood. The few scientists who are at the top of their fields and are most widely known were approached directly and specifically by the filmmakers. Jack Horner, for example, was a natural choice for *Jurassic Park* because the lead character in the film is based on him. Sometimes it is fairly obvious where a studio should go for consultants: e.g. to the National Severe Storms Laboratory for *Twister* or NASA for *Armageddon*. A number of consultants were conscripted by publicist Warren Betts, who specializes in recruiting science consultants for movie productions. And occasionally, they just fall into it. For example, Anne Simon, consultant for *The X-Files*, was first contacted by series creator Chris Carter because he was a friend of her mother's. Another informant became a consultant simply by being at work, literally at her desk at eight a.m. on a Monday morning when the director showed up at NASA's Jet Propulsion Laboratory, looking for someone to show him around and explain things.

But no matter who originally brings them in—producer, publicist, or (in one case) special effects house—the presence of science

consultants is effective only to the extent that the director, and to a lesser extent the producer, want it to be. The question remains: why? Why have a science consultant at all? Who brings these people in and chooses what to listen to and what to ignore? The answer here is the same for any project: it is *always* a highly-placed person on the production staff, usually the producer or director.

If the director/producer doesn't care, as was the case in two films referenced by informants, then the best a consultant can hope for is some minor impact on the visual aspects and look of the film. The two cases in which this occurred were considered rare. In one, the director was coming from an MTV/video-directing background, rather than being an experienced film director, and in the other there was an explicit focus on the entertainment aspect of the film, rather than the scientific aspect. As the science consultant said, 'I think that was really due to the attitude of the producer, the director. The director for [the film] was looking for an entertainment film. And had a very clear vision that way'. And indeed, that is what he got—a frenetic film containing a vaguely scientific theme and some window dressing science jargon, in which the perceptual reality of the situations and characters was very weak. Far more common was the sort of experience described by Gerry Griffin while working on *Apollo 13*:

Ron Howard said 'I want you glued to my hip'. And that's really the way I was. For the shooting of that film, I was kind of glued to Ron's hip, and he said 'if you see anything that you don't like in what we're setting up, or what we're about to do—you tell me'. He said 'I will probably throughout this film overrule you once or twice—but not very often'. And as it turns out, that was exactly the way it was; and all three directors I've worked with were the same way.

This creative tension between veritable and dramatic truth is apparent in the experiences of a number of informants; the important thing to note is that with very rare exceptions, they viewed this as a positive aspect of their relationship with the filmmakers. In fact, the consultants are nearly unanimous in their praise for the dedication of their employers to the inclusion of veritable truth:

Ron Howard and Tom Hanks and the rest of that bunch—

they really wanted to get it right. It was clear that Jodie Foster and Zemeckis really, kind of like Ron Howard and Tom Hanks had been on *Apollo 13*, really wanted to do this story and do it right. And Mimi jumped into this thing with both feet ... I think it's their desire to make—to get it as close to right as they can.

Roger and her [the producer] together were the two key people that really were dedicated to reality. And I guess that's a good way to pick someone if you want to look at it, is to look at Gale [Ann Hurd]'s various films ... she is an absolute, when you talk about deep, she asks *penetrating* questions about detail and she wants to get it right ... her commitment, I mean, it's a fervent passion. She feels that for her, any film she produces, the audience has to believe is real ... she and Roger together, they both made a commitment to make *Dante's Peak* as realistic as possible.

One consultant told a story about a scene in her film where the main characters are going to talk about astronomy, and the director needed last minute input:

They called me at three a.m. because they were doing that shoot where they [the characters] were going to run out, and they take a look at the sun rising on the solar panel fields. So they were doing that shoot, and I guess they just *had* to know, at three in the morning, what the answer was. So I told them, and the next day, I got this really pretty bouquet of flowers as a thanks for waking me up.

These experiences speak directly to the reasons most consultants are hired in the first place. These reasons have a lot to do with perceptual reality, and a little to do with all of the things that contribute to it—the filmmaker's attitudes towards art, commerce, prestige, and their own intellect; the relationship of the audience to these media, and cultural attitudes towards the division between fact and fiction.

Art and commerce

Why do the producers and directors care, however? Informants

generally interpret the producers' and directors' desire for veracity as simply a character trait. As exceptional filmmakers, they are perfectionists, and their desire to get the science 'right' is another aspect of that perfectionism; to make their product the best it can be. Informants sometimes cited specific idiosyncrasies to explain or describe this preference. One screenwriter/producer was the grandson of a famous medical research patron, and the consultant suggested that 'he sort of has this intellectual and scientific background. So he wants verisimilitude'. The *Mission to Mars* press kit talks about the concept of 'NASA-real', a more personal version of which was expressed by the informant of a different film who noted that for her director, 'his phrase was, he wanted things to "pass the JPL [Jet Propulsion Laboratory] laugh test". And he didn't want JPL engineers snickering, like we have at other movies'.

As commercialized as the entertainment industry is, these personal, or even artistic, motives should not be ignored: as Newcomb and Hirsch suggest, 'the goal of many producers, the most successful and powerful ones, is also to include personal ideas in their work, to use television as all artists use their media, as means of personal expression' (1994, p. 510). Many of those involved with the science blockbusters—Steven Spielberg, Robert Zemeckis, Kathleen Kennedy, Brian De Palma, Gale Anne Hurd—are among the most powerful people in Hollywood; they choose to make these types of films, and to give the consultants the roles they play. Established actors similarly pick and choose among their roles. Tom Hanks didn't have to appear in *Apollo 13*, or Robert Duvall in *Deep Impact*. Dustin Hoffman already had two Oscars under his belt when he made the (perhaps ill-advised) choices to play scientists in *Outbreak* and *Sphere*. All had relatively secure reputations prior to those projects and could be selective about their work.

Despite the common image of Hollywood as being driven by power and money-hungry executives who care nothing for art, those who work on these films and television programmes expressed quite serious artistic preferences relating to the sort of projects they work on, and the content of those projects. A producer with a long and extremely successful career related her partiality for reality- and science-based pictures: 'when I start to get involved in something and I feel the science fall apart, I'm much less interested ... I will often drift away from a movie if I feel that it doesn't seem to

have any *grounded* scientific credibility. If it starts to really get preposterous—that interests me *much* less'. Say what you will about his movies, Steven Spielberg clearly has great respect and affection for both scientific themes and scientists as characters; and he has that reputation among his peers.

The consultants quoted above made it clear that they believe the desire for veracity to be a personal choice for each filmmaker, and a choice that they respect. On one occasion, an informant actually called back after the interview was over (all the way from Hawaii) to gush again about the producer on whose film he had worked, and her fantastic personal commitment to realism. 'It can't be just total fantasy', he told me, 'and that's what she's dedicated to, and so she's my hero on that one. And she's really good. She's a missionary for real—scientific realism'.

Producers and directors are not the only ones who are, however; actors were also concerned that their portrayals be as accurate as possible. A number of actors spent time in the relevant government agencies—NASA for *Armageddon*, the NSSL for *Twister*—preparing for their roles. One consultant told stories of the time he spent on an actor's ranch helping him prepare for the role, where 'I saw again how a real pro does it. He was down to the detail of how do I hold my hands, when I'm doing this'.

At a more prosaic level, actors frequently sought out the consultants to review their dialogue, mannerisms, and character's behaviour prior to filming. Sometimes their actions were expressed as a desire similar to that of the directors and producers, an artistic decision the actors were making in favour of authenticity. One actor, who not only asked the consultant to review his dialogue but flew out a month before the shoot and 'just sat around in my office [and] in the library' asked for the informant's pardon if artistic license overrode scientific probity, saying 'although I really tried during this shoot to be as realistic as possible, there are some things that are beyond my control'. Though not all actors are quite so concerned with the perceptual realism of their portrayals, because they are professionals many expressed at least some desire to maintain the audience's believability in their character. One consultant related the story of an Oscar-winning actress who had come to him with the simple directive 'Don't let me do anything dumb!'

In trying to determine the full set of reasons consultants are

hired, however, it is imperative to look beyond personal desires for authenticity, and examine the pervasive belief in the entertainment industry that the public cares; both for perceptual reality and for some level of veritable truth in their science. This common notion about the audience is held by producers, publicists, studio librarians, and nearly everyone else in the industry I spoke to. One (more cynical?) consultant suggested that 'I was originally asked to work on [the film] as a technical advisor for [the director]. Basically so that sixth graders wouldn't write him nasty letters'. Industry informants who work on one of the major science fiction television programmes echoed this sentiment; despite saying that '[we] pride ourselves on trying to be science fact' they admitted that mostly, it's for the fans: both in a general way (producing the best product for the viewers, who they believe care about this) and because it is the only way to avoid massive negative fan response. One reports that even in a quiet week, when the show has been fairly accurate scientifically and consistent with previous storylines, they get up to five fans calling in *per hour* with comments and critiques.

Perceived audience preference is a guiding force in the economically obsessive Hollywood environment. A producer suggested that 'people are going to the movies, and in addition to the story, they want locations that they haven't been to, that you cannot get to, they want information that is new and exciting'. Part of this relationship with public desires, and thus the tendency to hire scientific consultants, can be traced to this belief that the public prefers films with realistic science in them (i.e. higher proportions of veritable truth), and that they make this preference known at the box office—a powerful incentive in an industry where, as the saying goes, you are only as good as your last picture. Producers and directors repeatedly state this belief in their movie press kits and other interviews [for example Robert Zemeckis in Thompson (1997) and Goldstein (1997); and Steven Spielberg in Begley (1993)]. Publicist Warren Betts said

Over the years, [in] Hollywood, a lot of studios commissioned major funding for doing market research, and we've found out that science and technology has become such a big thing now ... more young people are interested in those subjects than ever before ... so if you can make your movie sci-

entifically credible—in other words, the plot is fiction but the science the movie is based on the real things—that’s the best way to grab a market, to make people interested in your movie.

This sentiment was echoed by Kathleen Kennedy, producer of *Jurassic Park*, *E.T.*, *Twister*, and many other films, who remarked ‘I think, you know, the audience smells right away if something is absurd or preposterous, and it doesn’t make the experience as enjoyable as something that approaches either wish fulfilment or encompasses a narrative where you say “wow, maybe that *could* happen!”’.

It is a bit crude to suggest that producers and directors hire consultants (or direct them to be hired) because of what they might gain—personally or economically—but in a sense, that is what it boils down to; a question of determining the strategy of the filmmakers that leads to the consultant’s presence. Consultants are hired basically for two reasons: because people in the entertainment industry believe a strong sense of perceptual reality will help sell a movie or television show, and because many of those same people personally are interested in science and scientific themes.

■ IMAGES OF SCIENTISTS: LOOK IT OVER

The responsibilities of each consultant vary according to the circumstances of the individual production. All of these are keyed towards increasing the cues, both narrative and visual, that will overcome the referential unreality of the picture with a strong sense of perceptual reality. In determining the duties assigned to them, informants agreed overwhelmingly that the controlling variable is the consent and desires of the director. If the director (or producer) is concerned with scientific veracity, the consultant is an important member of the production staff. They hang out with the director, are continually consulted, and even have an impact on the plot and characterizations of the film or television programme. If they are not, the scientists have less impact on the final product than the caterers.¹⁰

The first requirement of almost all consultants is to go over the script. The minimum a consultant is generally expected to do is review dialogue and basic plot, checking for blatant errors and glaring mistakes. A typical experience as described by one informant:

[the studio says] ‘Well, we’ve got a draft of the script’. They will generally send that right away to the technical advisor; in every case that’s what’s happened with me. I got the script, it was before it was—well in an early stage. And they would ask you ‘please review this and give us any comments you have’. Well, that’s a page by page review and that’s the only way I knew how to do it, and it’s very detailed. And if I saw something that (a) was not said right I would comment on that, if it was not ... if the whole premise was bad, I’d say that.

Another consultant reported a more emphatic directive from his director, who was particularly concerned about the content and believability of his film:

We’d never seen the script. Which had already been written, it was finalized. And he says ‘hey, I want you guys to look over—stay here as long as you want, but—can you go over, I’ll get you a copy of the script tomorrow morning, I want you to go over it. No holds barred. I want you to look at every single word, every single scene. If something’s wrong, I want to know about it. If something’s wrong—rewrite it! If you think a scene shouldn’t be there, if you think we’re missing scenes ...’. He gave us carte blanche to do anything. Norm and I worked through the night, didn’t sleep, and I guess, he somehow or other he got us a copy of the script that night—I’ve forgotten the details; I know we had the script. In any event, we went through the script and came out with about a 15 pager [commentary], and you know, there were some scenes that were just wrong.

The director proceeded to implement the changes, some of which went far beyond dialogue corrections to the portrayal and characterization of certain roles. The relationship between the protagonist scientist and his supervisor was altered, and the process of science was changed so that, in the consultant’s words, it ‘show[ed] the fallibility of our profession’. The consultant added ‘it turned out in the final film, virtually everything, every comment that we made was inserted into the film’. What is interesting is that these were not atypical experiences. Far more rare was the consultant who didn’t have an input into the script—in 14 major Hollywood productions,¹¹

this occurred only once, on a film where the science was considered very weak, and the consultant thinks he would have had script input had the filmmakers not been 'sloppy and in a hurry'.

Often, the consultant is first called upon to verify, modify, or insert technical language into dialogue. Typical experiences include the following, each from a different production:

I had one woman that called and asked about—or I talked to and said 'does this line make any sense?' And I said nobody would ever say that, 'cause that's something, it implied a visual that implied she could *see* something happening that you can't actually see.

We were writing a sequence of the landing, the Mars mission going to land, and [the Producer] just asked me 'give me five or six lines of technobabble that sounds good', that would be reasonable, that would [be] something people would say when they're about to land on Mars.

The technical advisor ends up, particularly in the space business, or in the scientific setting, I suspect of any kind, you kind of end up rewriting or reworking a lot of the script. Because the writers, while they've got the notions, and the idea[s]—they're not used to saying it the way they're really said. And that's particularly true in space missions. Writers tend to put it in a very stilted tone and actually it's much more chatty than that, as you know—if you've listened to the ground conversations, probably heard some conversation inside a control center, it's disciplined, but it's not stiff.

The production of a television series is different from that of a film; by almost any comparison, television involves less money (per episode) and a much shorter timeframe than a motion picture production. Because of these limitations, the experience of consulting for a continuing television programme is different as well. Instead of locating a new consultant for each episode, television series tend to have one on staff (or at least on call): Andre Bormanis for *Star Trek: Deep Space 9*, *Star Trek: Voyager*, and *Enterprise*, Robert Ballard for *SeaQuest DSV*, and Anne Simon, who worked on *The X-Files*. In an interview, Simon revealed that instead of the one-time, intensive effort of a film consultant, she experienced a more episodic approach

to her work: the series creator would contact her, asking for a scientific procedure or rationale to support a specific plot point: 'usually Chris knows exactly what he wants—he wants an experiment ... he'll sort of tell me, he wants her [Agent Dana Scully] to be able to figure something out, or he wants to have this as the point'. The few interviews conducted with those involved in consulting on continuing network programmes seem to indicate that this slightly different pattern is more common in television, where a consultant's opinion is needed week after week, often on widely varying topics.¹²

□ *Lecture slides and Doppler radar*

But plotlines, story elements, and dialogue are only part of a consultant's contribution to the perceptual reality of a film or programme. At least as important, and arguably more so, is their input into the visual aspects of a production. Here their job is not just to inform the set designer that lava is orange, but to make the visuals jibe with the audience's previous visual experiences relating to the visuals at hand—how animals or dinosaurs move, or what a laboratory or volcanic eruption looks like. To that end, consultants reported changing rocket plumes, laboratory designs, and faux classroom lecture slides. They had input into how dinosaurs ran, lava flowed, and tornadoes were formed. Often they were responsible for background props, like the slides or the images that appeared on computer screens.

Some informants have amusing experiences attached to their prop duties: one informant recalled searching through garbage cans to find suitable computer printouts that could be scattered around behind the actors. Another, who had been asked to prepare 'lecture slides' for use by a character in a movie, related the following story:

I want the slides to look really good, so I had an Apple at that time, this was early, and there wasn't really Powerpoint, and good technology. So it was really tough for me to prepare these really pretty overhead slides—these nice images and stuff that I would—you know, I'm thinking cinematically as best I can; I want them to look cool. Though normally if I did a talk, I'd just write them out by hand, I want them to look cool for Lasker's movie ... [when] I get there [to the set], and the slides are now handwritten, right? And copies of what I

had made, that took me hours. And what Lasker said [is] that it didn't look realistic the way I'd done it, which of course is right, because I would have actually done it by hand, right? And so he had gotten somebody on the crew to just copy it by hand.

Once again, we see how the sorts of subtle cues invoked in creating perceptual reality work: the rougher, hand-drawn slides seemed more suited to the director's idea of what academic presentations should look like. And in fact, his instinct was right on.

In 'Iconic Devices: Toward an Ethnography of Physics Images', Sharon Traweek argues that graphs and charts found in physics labs around the world serve an important function in delineating and enshrining fundamentals of disciplinary knowledge (Traweek, 1997, p. 114). Here, in the world of the dream factory, they serve as symbols, abstractions that indicate 'laboratory'. They are present in on screen laboratories *because* they are found in real-life ones. In a real-world laboratory, they represent basic knowledge. Here, they represent people's expectation of the trappings of scientists' labs; to use Chris Toumey's term, they are 'conjuring science'. That is, they are transformed from useful knowledge documents to symbols that signal to an audience 'this is a place where knowledge is created', and to further legitimate the (faux) scientist's laboratory and mythical credentials. Because of this, while it is important that these charts, graphs, etc. exist on the set, their actual content isn't really important at all—as noted by the *Twister* consultant who related the following story:

We had given them some software to simulate, not to simulate, but actually to display some hurricanes ... funny enough, what they ended up using was one of the artefacts that the Doppler radar, one of the characteristics is it shows where targets, what we call ground targets [are]. The radar sends out a signal, but it's not like a laser, it's a broader-band energy signal that happens to hit things like trees and buildings on the ground—what we call a ground clutter pattern, which happens to be very colourful, and they ended up using that instead—so when you see in the movie, you see the colourful radar images, what you're really seeing is nothing more than a ground clutter pattern [instead of a tornado], but it made—

it did what they needed to do, and no one was the wiser unless you were a radar meteorologist.

Because almost nobody but a professional scientist would notice, in the cases where the director demands authentic material in their visual background science, as with the lecture slides in the anecdote above, it is probably reasonable to assume that these are instances where the personal artistic desires of the filmmakers for accuracy are coming in to play. However, when it comes to this background science, this adherence to veritable truth is mercurial; it appears to be fairly rare, and the consistent use of real science (as opposed to *real-looking* science) is not a necessary constituent of the science blockbusters. In these situations, the audience's perceived reality is more important than the scientists' referential reality. One consultant was actually worried that this casual attitude towards the visual background science might affect her reputation. During a scene in which a character is at a control panel,

doing calculations, talking about how they're coming up to Titan in the simulations. Well, in the actual filming what they used was Venus. They used Magellan [spacecraft images] of Venus. And I saw that, [and said] 'No! You can't use that! It's the wrong planet, everybody's gonna know!' And they said 'well, we already shot it!' And I was like 'but you can't use that! It's NOT Titan!' You know, people are gonna know! Well, it turned out when they cut the film, they were far enough away that you couldn't really see what was on screen.

This consultant was particularly worried because 'I used to work on the Cassini mission which was heading towards Saturn and Titan as we speak. So, [it would have been like] I don't even know my own planet!' Later in the same movie, however, the consultant appealed to the director to change some visual elements relating to rocket launches:

They had the plumes going off at these weird, canted angles. But rockets don't launch like that ... and the production assistant said 'oh, but [the director]'s a very visual person, he's obviously seen them launch like this'. And I said 'Well, can you find out from him which launch it was?' ... And he said 'it was this launch, from like, a jungle'. And I said 'was

it in China?’ And he said ‘yeah, yeah! China!’ That’s the Long March. The Long March crashed into a hillside, killed six people. Rocket plumes need to go uuuuuup, and they kind of curve and arch.

This time, the director changed the plumes and heeded his consultant’s advice. Of course, the audience was extremely unlikely to know, as long as the planet in the control room shot matched their expectations from TV coverage of NASA events as to what such things should look like; in other words, as long as the visual cues led to a strong perceptual reality. These two exchanges illustrate the duelling sensibilities at work on a film set. The director weighed the visual effect highly enough in the control room scene to override his consultant, but for the rocket plumes he chose, for either personal reasons related to a desire for veracity or for artistic ones related to perceived reality, that the consultant’s knowledge superseded his own visual sense.

In fact, most consultants (all but one) had some impact on the visual appearance of the film or television programme in one of two ways: set design or background material. Most often, the consultants are called upon to produce minor background props: charts, graphs, blackboard equations, lecture slides. Given the importance attributed to perceived reality, set design is the most necessary portion of some films; it has become the minimal level of scientific veracity filmmakers are forced to include.

While few people know the technical language surrounding a planetary spacecraft landing, because of news media coverage and the Discovery Channel, large portions of the public know (at least superficially) what the surface of Mars looks like, how big dinosaurs were, or the destruction a tornado can cause. Unless there is an awfully good explanation—or the production is an obvious fantasy—the public won’t buy astronauts walking around outside with no helmets on, or bright pink lava. Thus the title of a *Los Angeles Times* article intended for a general readership: ‘With Mars Movies, at Least They Got the Color Right’ (Monji, 2000).

In the rare case where only one area of a film is scientifically accurate, the one that gets chosen is the visual, as attested to by consultants and a number of other industry informants. For example, in one film that was considered scientifically terrible by scientist

informants, a consultant complained that his input was limited to the most inane reviewing of visual aspects: ‘the only thing that I could do was simply tell the director and the writers, the animators, “this is what it would look like if somebody were to [die in a horrifying way]”’.

The tension between filmmakers’ desire to get their picture to look authentic and having it look like they want it to in a visual sense cropped up when a minor television production company approached my anthropology department, looking for a consultant. In the name of participant observation, I accepted a position as their archaeological consultant. At our first meeting, all the producer really wanted was an accurate picture of what a ‘real’ archaeological dig looked like. He wanted the dig site to look authentic, but within the bounds of his *idea* of a dig site’s appearance. This included lots of shovels and pith helmets, and local natives doing the digging work while the archaeologist watched; basically, a low-budget, scaled-down version of the excavation site from *Raiders of the Lost Ark*.

The producer seemed disappointed when I informed him that archaeologists almost always do the digging work themselves, and few anthropologists have even worn a pith helmet.¹³ The alleged facts the television programme was going to suggest were preposterous, and one would hope anybody watching would recognize this—but the producer was convinced it would be okay if the sense of perceptual reality was strong. Though the producer preferred the idea of what he (and he assumed the audience) thought looked real to my actual experience with archaeological digs, in the final sketches I was shown my input had been included, producing a bizarre melange of a modern American archaeological dig site and a pulp-fiction version of the same.

□ *Meliorating negotiations*

Most of the time, however, consultants seem to have a moderate effect on a production; that is to say, they are not ignored, but neither are they as influential as the screenwriter or other major creative personnel (and it would be very odd if they were). But though mere script revisions or visual consultation may have been the original intent behind their employment, many advisors end up making greater contributions. A number of consultants were asked to



Simulacra becomes reality in the dig scene from *Raiders of the Lost Ark*. Despite hiring the author for his experience with actual archaeological excavations, a producer expressed disappointment and disbelief that real archaeological digs did not match this scene, his media-born impression of archaeology.

Credit: *Raiders of the Lost Ark* (Paramount, 1981).

comment on the premise of a film or plausibility of key plot points. One consultant let a job slip through his fingers because he told the studio flat out that the film's premise was 'kind of dumb'. The film (*Space Cowboys*) got made anyway—with a different consultant, of course. Another informant noted that one original scenario for *Twister* called for a single tornado that lasted several days, until the consultants pointed out that no twister could last more than a few hours, and the producers decided on the concept of an outbreak scenario of numerous tornadoes.

Consultants generally noted that they were brought on board during the pre-production stage, but often after the filmmakers already have a strong vision of what they want from the picture. For example, Gerry Griffin related that during one of the pre-production meetings before *Contact*, 'Rob Zemeckis, who directed *Forrest Gump*, just prior to this one, said "I need someone who knows something

about NASA, I've got to have a technical advisor to this". A person who had worked on a previous movie with Griffin (*Apollo 13*) then suggested his name to Zemeckis, and he was hired.

The basics of a film or television show—plot and characterization as well as infrastructure factors like budget and timeframe—already exist prior to the recruitment of the consultants. Because of this, the difference they can make, while sometimes surprisingly significant, is usually limited. Consultants tend to be brought in during the 'pre-production' phase of the process, after these aspects of the production are already in place. The precise moment in a production when consultants were brought in varied, and it is impossible to pin down a single decisive time when it happens. One consultant said that the experience of a scientific advisor begins like this:

They will contact you and say, particularly when they know a little bit about you, 'would you be willing to be a technical advisor?' 'Yeah' and they say 'okay, what stage are we? Well, we've got a draft of the script'. They will generally send that right away to the technical advisor; in every case that's what's happened with me.

This seems fairly typical, though most consultants didn't relate the exact stage of the script at the time they were brought on board. Looking at it from the other side, a producer described her approach to the early stages of consultant recruitment:

The first thing we'll do is we'll access scientific journals and we'll try to identify people who are working in the field, and then we'll often contact them. We'll tell them what we're doing. In some cases, people immediately want to get involved, in other cases, people think what we're doing is frivolous, so they don't necessarily want to get involved. So, the first challenge is to find people who are creatively stimulated in the same way we are, and are comfortable using their imagination.

For the archaeology television show, I had clearly been contacted at the very end of the pre-production process, when it seemed everything had been finalized except the dig location shot. On one occasion, a consultant's involvement occurred much later, and he felt this limited his input: 'it was personally frustrating to me,

because I really didn't have much control over the production ... I was pulled into the project largely after the scripts were written and committed'.

On the other hand, it should be noted that having a script written and completed (though not 'committed') didn't prevent other consultants from having an impact on their productions. In rare cases, the consultants are able to considerably alter the plot, portrayal, or characterization of people in the film. Two examples, from *Dante's Peak* and *Twister*:

Dr somebody, observatory director, and he was cast as the evil guy. Here Pierce Brosnan, Dr Dalton, you know him, he's out there. He's the kind of geologist, obviously a hero kind of a guy, and this evil director was representing big science and bureaucracy and wouldn't pay any attention to him, and he was basically cast as an evil character. He was absolutely WRONG. You know, he was wrong with his stupid bureaucratic viewpoint. Well, we pointed out in our rewrites of all those scenes that that isn't the way it is. I mean, there was never enough emphasis on how limited our knowledge is, how much guesswork is involved ... And so we cast him as a much more ... we changed the scripts to make him a much more credible person in terms of voicing his concerns and the doubts that all volcanologists have during eruptions. Which hadn't been present before. And so we instead—we basically showed the fallibility of our profession.

We [the National Severe Storms Laboratory] were supposed to be the corporate, evil ... the bad guys. We were supposed to be them. And in terms of well-funded, all the latest equipment, you know, that was supposed to be the Severe Storms Lab.¹⁴ As we—when we sat down and talked to them ahead of time, and this is to the credit of Kathleen Kennedy, when she came down and talked to us and said, you know 'what do you think? Can you help us out?' and we said we had seen part of the script and this portrays us incorrectly; let us walk you around. We showed her how our stuff is held together with wire wrap and duct tape, and we said, you know, this is a seat-of-the-pants, scrape-money-together operation, and so she, right then on the spot, said 'we will change

that' and so she did. And we ended up being, in the movie, more of an advisory capacity group, which was really quite a change from the original portrayal of the NSSL.

Interestingly enough, in both these cases it was the portrayal of the profession of science itself that was changed, and changed because the filmmakers were willing to do so based on the consultants' convictions, in the direction of a more honest depiction.¹⁵ If anything speaks to the cachet granted consultants in the age of the science blockbuster, it is this. It is almost unimaginable to consider the technical advisor for an older production, even one that trumpeted its use of consultants like *Destination Moon* or *Star Trek*, to tell the director to change the storyline of the film; certainly not to show science as *more* fallible and uncertain.

These portrayals of science are in keeping with the times; as is often the case, what is seen on screen is a reflection of current social trends. The public image of science, while still quite positive, is a long way from the image of the infallible, all-knowing scientists of the early Cold War era; the new portrayals more closely fit the current perception of science as a contested claimant to truth. But even now, these more realistic images of scientists were not on the minds of the filmmakers originally. They had to be brought to their attention by the consultants, and would not make it to the screen otherwise.¹⁶

■ UBIQUITY OF SCIENCE AND COMPROMISE IN HOLLYWOOD

At this point, it is almost inconceivable to have a major motion picture (and to a lesser degree, television programme) that features scientists or scientific themes without hiring a consultant, if purely for PR purposes (as some consultants, like the one who worked on *Volcano*, appear to be). At the dawn of the twenty-first century, even films that seem to have at most a tenuous relationship to 'real' science, like *Spider-Man*, have science consultants, and I was hired as the archaeological consultant on a shoestring budget, tabloid cable television programme. Producers and directors don't just use science consultants, they do it publicly; trotting them out at press conferences and devoting pages of press kits and releases to their participation. If the choice to use scientists was based purely on artistic

sensibility or a deep personal need to 'get things right', couldn't they use consultants without making a hullabaloo about it?

Signs of the commodification of science indicate how its inclusion is becoming routinized in the entertainment industry. Witness how a number of consultants have worked on numerous productions—up to three for several of those interviewed. Notice that there is a publicist who specializes in recruiting science consultants, and to some extent in managing their relations to the press, arranging their interview appearances and presence on press junkets. Science (or scientific knowledge) and those who possess it (scientists) are a *resource* as far as filmmakers are concerned, and are treated as such. Bourdieu suggests that scientific authority itself 'is a form of capital, which can be accumulated, transmitted, and even reconverted into other kinds of capital under certain conditions' (1999, p. 34). If this is true, then those 'certain conditions' are clearly found in Hollywood; the consultants spend their lives and careers accumulating scientific authority, and the production staff, seeing a direct correlation between that authority and box office capital, recruit them to transmit it (watered down through several mediating layers) to the public.

The increasing acceptance (if not use) of scientific information and science consultants can be traced back to this idea at the base of the science blockbusters; the notion being to make a film of such strongly implied perceptual reality that it seems more immediate to the viewer, and thus more appealing. As Kathleen Kennedy mentioned, 'that's what, again, lends a credibility—it's all those details that makes an audience believe that what they're looking at just might be based on something that has truth'. Of course, as many scholars suggest (LaFollette, 1990, p. 18; Saenz, 1994, p. 575; Sorlin, 1994, p. 63) people seem more apt to believe things outside their experience, and Shanahan and Morgan specifically note the difficult-to-prove concept they call 'perceived reality' (1999, p. 182)—that 'a greater belief in the veracity of television should render one more "susceptible" to cultivation'. In other words, the more real you think what you see is, the more likely it is to affect your belief in the veracity of that information.

If this is indeed the case, of course, than 'fooling' people into believing fictional science in a film or television programme is real by blending it with facts and using visual cues to strengthen the percep-

tual reality could have a significant impact on the absorption of scientific information (true or false) by viewers. Asked about the ability of the audience to discern the difference between fact and fiction, the consultants generally were hopeful, but not trusting: a sentiment expressed by the NASA employee who said 'I've gotta feel that most of the folks probably have a gut feeling like "wow, that's really cool, but we haven't seen that from NASA so maybe it's not possible yet"'.

The consultants also ended up with an appreciation for the necessities of dramatic truth in a work of fictionalized entertainment. One said 'basically, the rules were, if I knew for sure that something was true or false [the director] would listen, and it, I just—if it was just my opinion, or just something we really didn't know, then he had free reign with it'. Another consultant admitted 'It's not exactly a documentary, but it wasn't meant to be ... if you take it for what it is—entertainment, and you look at [it]; who would have thought, going into the field of meteorology, that someday they'd make a full feature, successful movie ...'. One even noted that in a major science fiction TV series, the producers specifically avoid including too much science: their intention is not a primarily sci-fi show, but a character-driven programme that happens to take place in the future.

Most informants said that their advice had almost always been heeded, often on all but one or two minor points, and on those rare occasions, the director had overridden them for an understandable dramatic or visual reason. A consultant who had previously expressed pleasure at his participation did note that when viewing the final scene of the film, he was somewhat disappointed: 'cinematically, of course, the goal is compromise between this desire to have it be realistic and have cinematic impact, so I understand why they did that. But at least in my perception, they had taken away some of the realistic parts'. Perhaps the most tolerant sentiment was voiced by a consultant who said 'no, it doesn't bother me. I mean, I guess it doesn't bother me because I just sort of understand why movies are made the way they are. Movies are made to entertain. Sometimes to teach, sometimes to give a message'. Another said 'I was realistic about it—about the amount of *scientific* input we were able to get in; it's one of those thing that I recognize artistic license and all of that. I don't expect them to be scientifically—this wasn't meant to be a scientific documentary'.

■ CONCLUSION

What does all this tell us about the place of science consultants in Hollywood? Do they have an impact on what we see? Consultants contribute to a production, but not in the same way that a set designer, screenwriter, or producer does; rather they are present to both increase the strength of the perceptual reality in a picture, and to lend the credence of their symbolic capital to the production.

It is interesting to frame the consultants' participation as a tangible expression of the power of the reality that they purvey. Prince's concept of perceptual reality posits that the inclusion of familiar, real-world cues in works or images of referential unreality can hold for the audience a visceral sense of reality or truth. Filmmakers are looking for 'real science' to increase the perceptual reality of their projects, for whatever reason—personal preference, box office take, what have you. To do this, they hire real scientists and engineers. These consultants come to Hollywood to tender their opinions, allowing the studios and filmmakers to stake some claim on the power of reality.

The notion of perceptual reality creates a framework for understanding the use to which the consultant's knowledge is put. The filmmakers themselves do not use this terminology but they serve it nonetheless, every time they direct the consultants to help them 'get it right' or demand the presence of realistic dragons. Their devotion to it is apparent in interviews with producers, directors, and publicists, as well as in the press kits and publicity junkets organized and distributed by the studios. In order to turn referentially unreal stories, creatures, and objects into perceptually real ones, images on screen must reference the real-world understanding, experiences and knowledge of their audience. Ironically a lot of that knowledge also comes from films and television, albeit sometimes documentaries or more 'realistic' programmes like *ER*. *Jurassic Park* was widely believed to be realistic partly because of its strong sense of perceptual reality, and partly because everyone was told how realistic it was, both in studio publicity and infotainment articles in newspapers and magazines (Begley's 1993 *Newsweek* piece is an excellent example).¹⁷

The institutional authority of science and its economically-driven commodification in Hollywood together form the basis of its symbolic capital among studios and production staff. Because consultants bring symbolic capital, and through the attributed drawing

power of perceptual reality the expectation of real capital, to a production, their participation and knowledge gets commodified by the entertainment industry. Talking about the production of the movie *Armageddon*, director Michael Bay said 'Our biggest challenge was to get NASA's approval. If we didn't get it, this movie would not have worked' (*Armageddon* press kit, 1998, p. 11). Bourdieu's suggestion that symbolic capital goes hand-in-hand with economic capital is borne out (Bourdieu, 1990, p. 119); or in this case, the intellectual authority or social cachet of science goes hand-in-hand with the potential box-office take.

The Hollywood production system has created an environment where scientific knowledge from the consultants is essentially put on tap and turned into a filmmaking element that can be used at will, like lighting or costumes. When a producer, director, or screenwriter wants some, they just turn on the tap by calling the consultant. This analogy seems particularly clear among television consultants,¹⁸ but it is true for the larger group as well. The expression of this commodification ideal is obviously much more involved, and in order to realize it consultants and filmmakers are engaged in a complex web of social relationships that determine what advice is solicited and used, and what mixture of veritable and dramatic truth ends up on screen.

As the studios explicitly seek to blend fiction and fact in the public imagination, the 'fact' that gets mixed in comes from the science consultants. Whether that is good or bad, the contributions of the consultants assist filmmakers in their presentation of dramatic truth and perceived reality—which arguably means they contribute to the industry's ability to confuse the public as to what is real and what isn't. The consultants do this by conferring a patina of scientific pretence over a foundation of fantastical ideas and events: by contributing their knowledge and experience, they provide the necessary cues that turn a referential unreality into a perceptual reality.

This academic assessment belies some of the personal relationships science consultants build with members of the production staff; and the power of these affinities should not be discounted. Informants in this sample often had a surprisingly powerful effect on the portrayal of science in the movies and on TV. Consultants clearly play a significant role in the world of the science blockbuster: often hired just to review scripts and dialogue, they frequently end up

having an even greater effect on the production, bringing a dose of scientific veracity not just to the actors' lines but to the basic plot and premise.

They also have a demonstrably positive effect on the characterizations of scientists in those productions, fleshing out one-dimensional stock characters into more complex, realistically human ones who can be both heroic and fallible. Sometimes, they literally turn villainous or evil characters into good (or at least neutral) ones, as with the National Geological Survey supervisor in *Dante's Peak* and the staff of the National Severe Storms Laboratory in *Twister*. It seems that significant credit for aspects of the media's current portrayal of scientists can be lain at the consultants' feet. The degree of pleasure consultants expressed with their experiences on the set was a surprise; even in the few situations where their suggestions and recommendations were overridden, the consultants were remarkably understanding about the necessities of dramatic truth.

Analysing the experiences of science consultants in the dream factory teaches us about the complex discourse of reality in the mass media. From the producers' self-professed desire for scientific veracity to changing the shape of rocket launch plumes and showing the fallibility of science, the relationship between filmmakers and the consultants who possess the knowledge they esteem and desire is a telling story of give and take between scientific knowledge and dramatic license. It is also a window into the cultural mores guiding social interaction in the often opaque media production industry. Acknowledging their inclusion in the filmmaking process is also a reminder that in an age where public confidence in the scientific community is three times greater than in either the television networks or the press (NSF, 2000, p. 8–18), the institution of science maintains enough symbolic capital to be used as a promotional tool by opinion-savvy filmmakers.

In a hyperreal world where researchers worry about children and the public's reaction to scientific knowledge (Gregory and Miller, 1998, pp. 1–10), these films may even positively affect the public opinion of science. One consultant, a former NASA employee, proclaimed 'I really think the movies, in the last 10 years, say, have really done a lot to spur the interest in science, because of its ability to show it [science] in a visual way ... there's just no media that can match it'. And after all, for the vast majority of the audience, the only

palaeontologist and volcanologist they've seen are the hero-scientists portrayed by Sam Neill in *Jurassic Park* and Pierce Brosnan in *Dante's Peak*. If even Tommy Lee Jones needs to call on their aid to save the day, then maybe science is cool after all.

□ NOTES

1. Top Grossing Worldwide films as ranked on the Internet Movie Database.
2. This paper is part of a larger ethnographic project looking at science in Hollywood. It is the result of several years spent among the natives of the entertainment industry, speaking with them, scouring their archives, observing what they make. During the course of this research, interviews were conducted with science consultants, producers, publicists, art directors, and a number of scientists with no relationship with the entertainment industry other than that of consumer.
3. What this means isn't exactly clear. Did a physicist look at it and say 'cool!' or was there a genuine scientific review of the deck plans and technology of the starship? The latter is certainly what the article implies (and is meant to imply), while the former seems more likely.
4. Though it should be noted that Mead was not a consultant *per se*—she didn't really comment on the content of the film; during the interview the staffers merely asked her about evolution and the possibilities of intelligent alien life. Apparently, Kubrick's associate Roger Caras shot footage containing interviews with prominent scientists, including B.F. Skinner and Mead. These interviews were included as part of an introductory sequence he filmed for *2001* in 1965. The sequence was shown only once, at the film's initial screening (see <http://www.admin.uiuc.edu/NB/97.02/07cyberfilm.html> for more information).
5. These numbers don't exactly match up (14 consultants, 20 projects, and four documentary/educational programmes versus five people who worked on them), because some consultants worked on multiple projects, and three people worked on a single educational project. In fact, three of the consultants had worked on three projects each, turning their consulting into a fairly serious sideline.
6. Of course, box office is an extremely selective way to measure a film's success. But it does give a valuable insight into the sheer volume of the audience for a particular film, which is certainly a useful indicator as a measure of success.
7. A note on the form of NSF report page numbers: the report in question, *Science and Engineering Indicators 2000*, is not conventionally paginated; pages are numbered sequentially by chapter, and then by page. So '3-12' does not refer to pages 3 through 12, but rather to chapter 3, page 12.
8. That said, this is not an indictment of either of the big volcano movies, *Dante's Peak* or *Volcano*. Though *Volcano* is clearly not particularly concerned with scientific veracity, the Fox studio research librarians claim to have put in many, many hours researching factual material for it, and have the research file to prove it.
9. The technical definition of a blockbuster is a film that brings in over \$100

million in box office earnings; the term (and category) came into common use following the success of *Star Wars* and *Jaws*. However, it is only since *Jurassic Park* that Hollywood has released a rash of films that combine the following four characteristics:

1. being pitched by the studios as major blockbuster movies;
2. explicitly listing science consultants in press kits and articles;
3. having scientists as main characters; and
4. specifically pitching the basis in 'science fact' of the films in question.

Saying a film is pitched as a 'blockbuster' means that it is specifically produced and promoted as a big 'event' movie, under the post-*Star Wars* rationale that a movie with a big enough budget, expansive story, and good publicity can be released during the prime movie-going periods (summer or, to a lesser extent, Christmas), and surpass the all-important \$100 million mark. The use of science consultants is not unique to these films; over the years many pictures have used technical consultants—from historical dramas like *The Vikings* to *2001*. The prominence of these consultants, however, is greater than ever in the science blockbusters, a visibility that has to do with the place of reality in modern cinema and (of course) marketing ploys. *Jurassic Park*, for example, was heralded not only by standard advertisements and billboards, but with a cover story in *Newsweek*, which devoted four pages to the science behind the film, but only a single one to an actual review (Begley, 1993). During the press junket for *Deep Impact*, Viacom/Dreamworks trotted out the scientific and technical consultants for a moment in the media spotlight, hoping to highlight the reality of the picture and make their film more immediate, more newsworthy, and one could argue, more prestigious. Additionally, the grounding in 'reality' these films feature is a commonly promoted angle: director Michael Bay, when asked about his movie *Armageddon*, noted that an asteroid colliding with the earth (as depicted in the movie) is not a matter of fictional 'if', but factual 'when' (*Armageddon* press kit, 1998, p. 22).

10. The other prime factor that has an effect on the science content is assorted studio requirements, the most commonly stated ones being time constraints and budgetary limitations.

11. By 'major Hollywood productions' I mean either feature films or network television programmes; so this number excludes both made-for-television movies and cable television programmes. The differences can best be measured in terms of budgets (major productions have much higher ones, and can afford more of the bells and whistles, like consultants) and viewership (major productions have audiences that are an order of magnitude larger).

12. Unfortunately, the dearth of television sci-fi programmes, especially those that employ consultants, prevented a sample size significant enough to reach any serious conclusions in this regard.

13. Hilariously, the producer also attempted to assure me that he would include a 'real' scientist (or archaeologist) to provide an 'objective counterpoint' to the suggestion the production was making—that the KGB had uncovered evidence in

Egypt of ancient visits to Earth by extraterrestrials. Obviously, any true objective counterpoint would be saying the producer was completely nuts.

14. From page 33 of *Twister: The Original Screenplay* (Crichton and Martin, 1996), describing the evil-doer's vehicles: 'the four vans come right up to us, and then pull over at an angle onto the opposite side of the road, one after another, matching angles exactly. Then, in a group, they all back up, swinging around in a 180 degree so they face outward, ready to go again. The silver vehicles are sleek. Stenciled on the side of each vehicle is NSSL ATMOSPHERIC RESEARCH TEAM'.

15. 'More honest' in this case meaning that the films show scientists less as one-dimensional evil maniacs; with less power and more modesty, basically just as human beings doing a job.

16. Interestingly, this shows the consultants themselves are quite aware of the fallibility of scientific knowledge and, though they might not recognize it as such, the constructed nature of scientific beliefs.

17. Because of this, *Jurassic Park* itself has become a realism benchmark, the trust placed in its veracity morphing it into a second-order transmitter of scientific fact. Dinosaurs that appear now in television or the movies do not necessarily have to look like the real creatures did 60 million years ago, but they do have to resemble the ones from *Jurassic Park*. People's perception of what dinosaurs or volcanoes look like often comes to them through the same media they will be judging on the basis of that perception.

18. A member of the production staff of one science fiction television programme said that the staff was charged with locating relevant consultants for each week's episode. The staff would be told what the week's plot was, and they were to go out and locate a one-shot consultant. Though the show has a permanent science consultant, they have called in freelance consultants in fields ranging from oncology to anthropology.

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