Fine words: aspiring writers are lectured by film luminaries (clockwise from top left) Frank Spotnitz, Alex Singer, Martha Coolidge and Christopher Vogler.

C. SCHWARTZ

Hollywood or bust

Last month, a handful of scientists who have toyed with the idea of writing for the movies were given a masterclass by Tinseltown's finest. Jonathan Knight joined them.

In the 1997 disaster movie *Volcano*, whole sections of Los Angeles are demolished by lava. For advice on the film, the production crew turned to Christopher Vogler, one of Hollywood's top story consultants. "Lava actually makes a tinkling sound like glass as it cools," Vogler says, "but they wanted it to roar like a freight train. Any volcanologist who saw the movie probably thought it was a comedy."

On a bright summer morning in mid-July, Vogler recounted this anecdote to a group of 15 scientists. They had come to Hollywood from all over the United States and from various scientific disciplines for a weekend workshop on screenwriting. Their goal was to learn how they could help improve the image of science and scientists in the movies. "You face an uphill battle with this stuff," Vogler continued. "But it's a good fight."

The scientists sat around a large conference table in the sunny library of the American Film Institute (AFI), a writing and directing school nestled on a hillside just minutes from the world's largest film studios. Shelves of scripts lined the walls and dozens of film stars — including Michael Caine, Sean Connery and Audrey Hepburn — gazed down from posters as Vogler and a cast of Hollywood luminaries gave their best advice on everything from writing a good script to getting a production company to read it. At times the challenges seemed demoralizing, and yet by the end of the workshop, the scientists were, if anything, inspired.

"It gave me the motivation to consider screenwriting as a serious hobby, if not a potential new career," commented Leo Cheng. Currently, Cheng works at the Jet Propulsion Laboratory (JPL) in nearby Pasadena as a science-planning engineer for Cassini, the spacecraft now orbiting Saturn. "I learned a great deal," he said.

The portrayal of science and scientists in the mass media are two separate but related issues, both of which have long been a source of irritation for real-life researchers. We all know that scientific accuracy generally falls by the wayside when it might interfere with dramatic effect. How exciting is a silent explosion in outer space, after all? And if it took decades instead of days for global warming to flood New York, the current blockbuster *The Day After Tomorrow* might have made less of a splash. Still, this leaves many scientists worried that such movies serve only to misinform a public whose knowledge of science comes mainly from the big and small screens.

> "In film and television, scientists are often quirky, nerdy, obsessed, reclusive, self-important and not infrequently mad. These are not character traits that appeal to kids."

But it is the issue of how scientists themselves are portrayed that brought many of the participants to the workshop. Diandra Leslie-Pelecky, a materials scientist at the University of Nebraska in Lincoln, fears that media stereotypes are turning generations of children off any thought of a career in research. In

CAPITAL PICTURES

Waiving the science: *The Day After Tomorrow* favours drama over accuracy for the flood of New York.

film and television, scientists are often quirky, nerdy, obsessed, reclusive, self-important and not infrequently mad. These are not character traits that appeal to kids, she says.

Leslie-Pelecky has had numerous conversations with children about their views on scientists. She is leading a project funded by the National Science Foundation that is investigating the impact of the media on children's attitudes. She has encountered many children who believe that the researchers who have visited their elementary schools aren't the real McCoy. "They might say the person was too 'normal' or too good-looking to be a scientist," Leslie-Pelecky told *Nature*. "The most heart-breaking thing is when they say, 'I didn't think he was real because he seemed to care about us'."

Much misunderstood

For others at the workshop, improving the public's perception of scientists was of personal importance. "Whenever I meet a non-scientist, I'm afraid they misunderstand what I am," says Michael Strong, a graduate student in biochemistry at the University of California, Los Angeles.

About five years ago, such concerns led William Wulf, president of the National Academy of Engineering, to call his friend Alex Singer, a television director. "He was worried about the decline in the number of young people entering the sciences, and he wondered whether the media could be having an effect," recalls Singer, whose credits include *Hill Street Blues*, *Star Trek: The Next Generation* and *MacGyver*.

The discussion rumbled along for some time until the idea for the workshop finally gelled. Martin Gundersen, a physicist at the University of Southern California in Los Angeles and an acquaintance of Singer's who has served as a science adviser on Hollywood films, helped to arrange funding from the Air Force Office of Scientific Research. The show was on.

Lights, camera, action

More than 50 scientists applied to participate when the workshop was announced in May. The 15 chosen had all demonstrated an interest in screenwriting, Gundersen says, and each came to the workshop armed with a script idea.

Carl Carlsson, an environmental engineer with a Houston power company, described his idea for a screenplay about a 14-year-old girl growing up on the Moon. James Brown, head of discovery bioinformatics at GlaxoSmithKline's facility in Upper Providence, Pennsylvania, brought along his bioterror-themed idea in which recent advances in gene therapy are twisted by terrorists to do more sinister things. And Ron Garret, who designs computer modules for martian rovers at JPL, came with a draft script called *The Cure*, in which a mysterious disease changes the lives of three molecular-biology graduate students.

"I was very intrigued by all of your ideas," said George Walczak, a screenwriter and graduate of the AFI. But as the scientists thrashed out their ideas with the instructors, many of them learned that they were missing key elements — without which their screenplays had little chance of success.

The formal structure of a film script is fairly standard. It runs to around 120 pages, roughly a minute per page, and is generally divided into three acts of about 30, 60 and 30 pages, respectively. The script details the action and dialogue but leaves most of the specifics of shooting, such as camera movement, up to the director.

The surprise for many of the scientists was the overwhelming importance every one of the workshop's instructors placed on character-based narratives. The message, in a nutshell, was that the main theme of a dramatic film cannot be Mars exploration or evolution or even a scary virus. Instead, it has to be a protagonist and his or her 'journey'. Any scientific content is incidental.

Hero worship

So, for example, the 1997 film *Contact*, based on a book by the late astronomer and science popularizer Carl Sagan, would not have worked had it just been about the search for extraterrestrial intelligence. It succeeded as a film because it was about an astronomer — played by Jodie Foster — who dreamed her whole life of reaching the stars and who battled numerous obstacles on her journey. This eventually took her to a distant corner of the Universe to meet alien beings.

A good script is essentially the classic hero's journey, key elements of which can be found in everything from Homer's *Odyssey* to aboriginal folk tales. The stages of this journey are outlined in a number of scriptwriters' guides, including Vogler's seminal book, *The Writer's Journey: Mythic Structure for Writers*, which has become a key reference for many Hollywood screenwriters.

By this test, many of the scientists' script ideas were not yet fully formed, and the instructors had a number of ideas for improving them. Taking Brown's bioterror idea, Vogler suggested allowing the central character, a cancer epidemiologist named Paul Edwards, to express a wish early in the film. It could be to win the Nobel prize or to overcome some character flaw, Vogler said. "When the protagonist makes a wish, the story immediately wakes up and pays attention," he explained. The audience then has a goal by which to mark the character's progress.

The challenge, then, is how to bring science into a script that is driven by the story of its protagonist. "I read things in *Science* and *Nature* every week that are absolutely fascinating," said Tom Katsouleas, a plasma physicist at the University of Southern California, citing a *Nature* News Feature

published in February about the last universal common ancestor, the theoretical first cell that gave rise to all cellular life on Earth (see *Nature* **427,** 674–676; 2004). He asked the instructors: "How do we put something like that into a script about character?"

Frank Spotnitz, who for four years was executive producer of the TV drama *The X-Files*, suggested that the protagonist might have to recreate this creature to save the planet. "If it were for *The X-Files*, I'd think about how it could start killing people," he added.

Life-or-death situations are essential. The stakes must be high in a screenplay, whether for film or TV. Walczak calls this the "law of thermodramatics". "If you aren't sure what the stakes are, find out what your main character cares most about in the world," he urged the scientists. "Those are your stakes."

F. DUHMEL/WARNER BROS/SOUTHSIDE AMUSEMENT/KOBAL COLLECTION

Journey's end: in *Contact*, Jodie Foster's character realizes her dream of reaching the stars, while portraying the life of a radio astronomer reasonably accurately.

Lab liabilities

The realities of screenwriting are sure to disappoint those scientists who wish the world at large could get a more realistic glimpse of what their daily lives are like. As with many other professions, the daily drudgery of research does not make for good movie action.

Spotnitz told the group he toyed with the idea of showing the details of an experiment on *The X-Files*. The crew filmed a half-hour segment of Agent Scully working in the laboratory, but killed it and rewrote the script after everyone agreed it was far too boring. Singer concurred: "Most scientific work is unfilmable."

On top of all this, the screenplay writer has to consider a factor that book writers are free to ignore: cost. For instance, making a character age 15 years over the course of the film might be important to the story, but the producer who reads it will immediately think of the hundreds of thousands of dollars it costs to artificially age the actors and shift the time period of the sets and costume. Similarly, writing "a freight train passed by" has enormous filming implications because of the time and expense required to back up a train for a second take. Producers care about cost, and writers ignore this at their peril.

> "There are a lot of people who make very good money writing very good scripts that never get made."
> — Alex Singer

Even after hearing this, the scientists in the workshop remained enthusiastic. "Show me the constraints and I can work within them," said Leslie-Pelecky. "That's what I do for a living."

But there was more to come. Writing a good script is only the first challenge. In particular, a producer then has to be convinced to buy it. The usual process involves finding somebody who knows somebody at a production company just to get the script in the door. Then it goes to 'readers', who are often young, aspiring screenwriters themselves. Their safest bet is to say 'no', rather than risk getting egg on their face for passing a lousy script on to a production executive. "They reject most of what comes in, and nine times out of ten the executive rejects what the reader passes," said Spotnitz.

Hollywood's dream factory can afford to be so picky because of the sheer number of scripts that come in every day. So far this year, 40,000 script ideas have been registered with the Writers Guild of America, according to Singer: "And this is a slow year."

Killer blows

Once a company has bought the option to make a movie, the producers are likely to want the writer to rewrite the script to their specifications. If they aren't pleased with the new version, they may kill it. If they are, they still need to find a director interested in making the film. If they don't, again the script dies.

There are so many ways for a script to die after it is optioned that many professional screenwriters don't have a single movie credit. But they keep at it. "There are a lot of people who make very good money writing very good scripts that never get made," Singer told the scientists.

Despite all this, there is hope for the future of science in film. For one thing, some directors are starting to care about scientific accuracy. Director Martha Coolidge, who made a presentation at the workshop on Sunday afternoon, hired Gundersen as a science adviser for her 1985 comedy *Real Genius*, about some brainy kids who develop a new high-powered laser. "The labs had a very real look, we even had a laser on the set," Gundersen said. "Comments from people in the field were uniformly positive about the accuracy of the science."

More recently, *Contact* gave a reasonably accurate portrayal of the work of radio astronomers. *Apollo 13*, the 1995 film about the ill-starred Moon mission, contained numerous accurate details about space travel. Such attention to detail raises the bar for other films, Singer claimed: "You can't make a stupid movie about the Moon any more." Even children's movies such as *Finding Nemo* have won plaudits for their attention to scientific detail (see *Nature* **427,** 672–673; 2004).

Workshop participant Valerie Weiss, who recently completed a PhD in biochemistry and has directed and produced two short films, is optimistic about the prospects of getting more and better science into the movies. Unlike most of the participants, Weiss has already turned all her attention to film. She founded a film programme while she was a graduate student at Harvard Medical School and moved to Hollywood in 2001 to pursue film-making full time. She now has a script idea for a movie about a scientist, but asked *Nature* not to reveal it in detail. "You can be scooped in film-making just like in science," she said.

Whether any of the ideas discussed at the workshop will end up on the big screen remains to be seen, but the next steps are in the works. Gundersen is thinking about holding a five-week workshop at the AFI next year, at the end of which each participant would have completed a script. Joe Petricca, vice-dean of the AFI Conservatory, has offered to organize screenwriting instructors or professional readers to provide feedback for any of the current participants who can submit the first 30 pages of a script by 1 October.

Brown, who is now fired up to work on his bioterror script, plans to take Petricca up on this offer. He feels better prepared knowing what challenges lie ahead. "It's daunting trying to get a paper into *Nature*, too. Yet people do it," he said after the workshop. "This is just the same." ■

Jonathan Knight writes for *Nature* from San Francisco.