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THE MOUSE WITH THE FLYING BICYCLE

JOHN LYNCH *has a psychology degree from the University of London. He joined BBC Science in 1976 as a researcher, and has, since 1994, been the editor of the BBC* Horizon *program, which has won numerous international awards. In 1998 he also became deputy head of BBC Science.*

One of my children's favorite stories is about a mouse called Herbert, who makes a flying bicycle. Full of inventive genius, he is the toast of the countryside, and his jealous rivals plot his downfall by stealing the essential starting-pin for his airborne machine, only to discover that the cunning mouse has a spare in his waistcoat pocket. Another favorite is about a little girl who climbs into paintings at the national gallery and nearly causes havoc by altering the history of the scenes that artists had captured.

None of these stories share a common theme, and none are about science. Yet they share something fundamental with an event in chemistry, the discovery of buckminsterfullerene, or "buckyballs" (the molecule C_{60}), about which I made a *Horizon* television documentary a few years ago. What made this discovery fascinating was that it was a terrific story not only about science, but also about the human interactions, emotions, and ambitions that intertwined with the science. When reading about mice, paintings, and bears with little brain, my children are enticed into worlds of imaginative invention, of artistic representation, and of social interaction and friendship. While watching the *Horizon* program, viewers were drawn into a world of molecular theory, the experimental method, and imaginative reasoning, and were eager to know what would happen next. In this, the *Horizon* program and the discovery of buckminsterfullerene are just like any other story: Whatever the subject, if a story is good, viewers, listeners, and readers will be drawn into it.

Stories are key for those of us who spend our professional lives communicating science. I have been making science documentary films for television for over 20 years. During this time I have made programs that try to reveal science in its richest details: its activities, its applications, its methods, its philosophies, its personalities, its policies, its social and political entanglements, its magic and wonder. Our job as journalists and filmmakers of science is to be alert to the key issues in the world of science that matter to nonscientists, and to provide them with a framework within which they can make their own judgments. But along with that laudable goal comes a creative challenge: how to reveal science as enticing and as relevant as we passionately believe it is.

Working in science television, we are split between science as a wonderful world of discovery and knowledge, and the nature of television viewing, a world filled with people reaching for the remote control to change channels. Our lives are spent trying to stop them from doing so. The BBC TV *Horizon* series that I now head produces programs for mainstream, primetime television, which it has been doing for almost 35 years. In its last two series *Horizon* covered topics as diverse as life on the MIR spacecraft, Dolly, the first cloned adult animal, research into preserving the lives of very premature babies, the discovery of meteorite ALH 84001 and its implications for life on Mars, how bodies preserved over 2000 years in peat bog tell a story about the life of our ancestors, and many others.

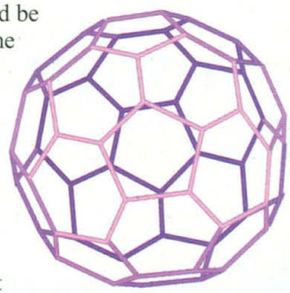
Some in the scientific community almost regard us as a televised form of scientific publishing. But this is far from the reality. The series' primary target is a general audience, not the scientific community—although it tries to reflect accurately the world of scientists—and it therefore has to appeal to ordinary people who may or may not have an interest in science. Research shows that most of our viewers do not realize that they are watching a science documentary at all. People watch, above all, because they like to be told a good story. Of course there are subjects that always seem to draw people's special interest and passion, such as volcanoes, archaeology, dinosaurs, and planetary science, because we all know, at least in general terms, what they are about and can therefore relate to them. Attracting viewers to programs on these subjects is comparatively easy. But mostly the general public is left cold by chemistry, mathematics, geophysics, molecular genetics, and so forth. The list of apparently unappealing scientific subjects is long. Yet as we near the end of this century, the questions that emerge from many of these disciplines will have an enormous impact on people's lives, and the job of science filmmakers and the scientific community is to make these subjects as enticing as any other program on television.

Many scientists have told me that they were first attracted to science as children by watching our programs. While this is a great responsibility for science broadcasters, we cannot provide a comprehensive education in science during primetime programming. Television is *bad* for relaying facts, and information that cannot be repeated: Films start at the beginning, and go to the end; you cannot turn back, like in a book; there is no indexing or cross-referencing. Television is *good* at conveying moods, giving impressions, drawing characters, and revealing conflict. In other words, television is drama. And science documentaries are just the same. Like dramas, we tell stories about life: It's just that the slice of life we draw our stories from happens to be science. Sometimes a story will require an audience to understand some unfamiliar science, in which case they will be motivated to learn what they need to know. For instance, when in the case of C_{60} scientists had to understand the molecular structure of diamond and graphite and the nature of carbon-hydrogen bonding in order

ILLUSTRATION: ALLAN M. BURCH

The author is at BBC White City, 201 Wood Lane, London W12 7TS, UK.

to figure out how C_{60} could be wrapping around itself, the audience, too, had to learn about molecular structures. But sometimes the details of the science are not necessary to the story at all. In those instances I do not try to explain them.



The molecule C_{60} "buckyball."

I find it perplexing that some in the scientific community expect every science program to fulfill a direct information-giving role. A television program about art is not required to provide a detailed description of the technical methods of artists in order to discuss an interpretation of their work, unless it is essential to that discussion. Political programs are not expected to provide details of the full legislative framework leading to a particular parliamentary argument, only what is needed to follow the story. But science programs are criticized if they do not provide scientific details, even if they are not essential to the narrative. In a recent article in a British television industry journal, a Nobel laureate criticized a film of mine—which told the extraordinary story of Andrew Wiles's proof of Fermat's Last Theorem—for having failed to attempt an explanation of the proof. Indeed I did not attempt it. The full proof is incomprehensible to all but a handful of the world's top mathematicians, and the key insight that led to Wiles's now famous success, after 8 years of lone intellectual struggle, was beyond even his ability to explain to nonmathematicians such as myself. In the *Horizon* program the mathematics deliberately took second place to notions of strategy, determination, obsession, and childhood dreams—all in the world of pure mathematics—which made it an uplifting story that struck a chord in many viewers. It taught them little in the way of number theory, but revealed maths as a potentially emotional and thrilling human activity, and I suspect that it enticed more people to investigate it as a possible career than a detailed description of the proof itself would have.

It was the discovery of buckminsterfullerene that made me realize the power of a strong story. Here was a subject as challenging as any that a program maker could imagine, and when I told my colleagues that I was going to make a film about a new molecule that one could not see, one could not hold, and that had no practical use, they said that I was mad. But it was the best science story that I had come across in 15 years of broadcasting. I had read about the new molecule in *Nature*,* and so phoned up one of the authors of the paper. He was not there, but I spoke to his graduate student, Lowell. Like all trained journalists, I asked him what use was C_{60}, what would it do for humanity? None and nothing so far, was the answer, but that really did not matter, for he said to me: "What a time to be in chemistry; to be part of a great new discovery like this. It's a revolution. A whole new world of chemistry. I'm so lucky I was there." If Lowell had not said all that, I would probably have abandoned C_{60} as an obscure molecule to remain in the pages of specialized scientific journals. As it was, I was talking to a person full of enthusiasm, excitement, passion, pride, and conviction. If molecular chemistry could produce this, then it had to be my story.

MIR space station

"OUR JOB AS JOURNALISTS AND FILMMAKERS OF SCIENCE IS TO BE ALERT TO THE KEY ISSUES IN THE WORLD OF SCIENCE THAT MATTER TO NONSCIENTISTS, AND TO PROVIDE THEM WITH A FRAMEWORK WITHIN WHICH THEY CAN MAKE THEIR OWN JUDGMENTS. BUT ALONG WITH THAT LAUDABLE GOAL COMES A CREATIVE CHALLENGE: HOW TO REVEAL SCIENCE AS ENTICING AND AS RELEVANT AS WE PASSIONATELY BELIEVE IT IS."

Dolly

The film that resulted won prizes across the industry and the scientific community, not because the subject mattered to people, but because it told a remarkable story of conflict, competition, hope, fear, failure, and success, and inspired those who saw it. But along the way, in order to follow the story, the viewers had to gain insights into fundamental laws of chemistry, into the application of science for commercial ends, into the parlous state of research funding, and into the value of blue-sky research. Hit head-on, none of those issues would have drawn in uncommitted viewers. With a strong story, they did.

As a science program maker, I have one plea to the scientific community. I know that deep within your subject lies fascination and wonder, and information of immense importance to us all. But do not tell me about aerodynamics and bipedal locomotion. Tell me the story of the mouse with a flying bicycle! That way, I can take your science to reach the widest audience and allow them to glimpse your world, and to appreciate what you do.

*W. Krätschmer *et al.*, "Solid C_{60}: A New Form of Carbon," *Nature* **347**, 354 (1990).

ILLUSTRATION: TERESE WINSLOW; (DOLLY) I WILMUT/ROSLIN INSTITUTE/*NATURE* **385**, 810 (1997); (MIR) NASA