BRITAIN'S NUCLEAR SECRETS: INSIDE SELLAFIELD

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Lying on the remote north west coast of England, Sellafield is one of the most secret places in UK, and even one of the most controversial nuclear fuel reprocessing and nuclear decommissioning sites in Britain. The film director Tim Usborne let us enter into the world's first nuclear power station, revealing Britain's attempts to harness the almost limitless power of the atom. It is precisely the simplicity and the scientific rigor used in the film to speak of nuclear, which led this documentary to win the Physics Prize supported by the European Physical Society at the European Science TV and New Media Festival and Awards 2016.

◂P. 21: Jim Al-Khalili is a British Iraqi theoretical physicist, author and broadcaster. He is currently Professor of Theoretical Physics and Chair in the Public Engagement in Science at the University of Surrey. He has presented a number of science programmes on BBC television and is a frequent commentator about science in other British media.

You will be wondering if EuroPhysics News is really about to reveal the secrets of English nuclear. And that's what thousands of spectators have asked for in front of the award-winning documentary film "Britain's Nuclear Secrets: Inside Sellafield" by Tim Usborne. Winner of the Physics Prize at the European Science TV and New Media Festival and Awards 2016, the documentary brings you into one of the biggest nuclear power plants in the world, Sellafield.

Lying on the remote north west coast of England, Sellafield is one of the most secret places in UK, and even one of the most controversial nuclear fuel reprocessing and nuclear decommissioning sites in Britain. Moreover, it is the site of the world's first commercial nuclear power station to generate electricity on an industrial scale. In just one hour the nuclear physicist Professor Jim Al-Khalili presents to the general public the physics that allows UK to produce energy. The narrative rhythm is intense, the spectator discovers step by step the most dangerous substances on earth, the nature of radiation and how to split the atom. The crescendo has its maximum when cameras enter into one of the nuclear reactors. The documentary faces one of the hottest physics issues for civil society, the nuclear production of energy, revealing Britain's attempts - past, present and future - to harness the almost limitless power of the atom.

It is precisely the simplicity and the scientific rigour used in the film to speak of nuclear, which led Tim Usborne to win the Physics Prize supported by the European Physical Society. The European Science TV and New Media Festival started in 2001, as a way of recognizing and promoting the value of science in non-science TV productions, and notably TV drama which reach large audiences. Following early success, the festival expanded its agenda and now encompasses science and technology in all genres of television and new media. Since 2015 the festival assigns a special prize to productions having physics as science subject. Andrew Millington, Festival and Awards Director, explains us that three criteria are used to judge entries. Firstly, the quality of the physics being presented. In other words, the physics message. Secondly, the production values of the films, such as the quality of the filming, pacing of the narrative and the script. And thirdly, whether it was innovative in some way, either through selection of the content or the method of presentation.

Behind a documentary like this, one wonders how much work there is. Not just for direction issues, but also for the scientific tasks needed to give scientific validation to the story. That is why we interviewed the film director, with some questions aimed at understanding what are the steps for the realization of such a bold project.

Tim Usborne is a UK based documentary film maker, mainly specialising in science. He has made films about the Nuclear Industry, Chemical Weapons, a history of Trains, Quantum Physics, Alien Life, the History of Electricity, and a 3D series about the lives of insects. His films have been broadcast by the BBC, Channel 4, Discovery, National Geographic Channel and many other UK and international broadcasters. He is currently producing BBC landmark series, The Sky At Night, about astronomy which has been on air for over 60 years.

▸ FIG. 2: On the 18th November 1983, something happened here that damaged Sellafield's reputation irrevocably. That morning scientists at Sellafield looked out to sea and saw an inky black slick. It was a slick pouring out of Sellafield. People started questioning whether the whole plant should be closed down altogether . In the picture, the troupe filming the beach where the accident took place.

◂ **FIG. 3:** The film Director, Tim Usborne, is a UK based documentary film maker, mainly specializing in science.

Antigone: Nowadays, scientists are asked to be good communicators. Social media and the intensive use of videos to present scientific results require specific skills. What is needed to produce a good scientific documentary is the ability to translate the scientific language into everyday life talk. How did you manage to do it? Have you had any specific studies or courses? If a young scientist decides to take this road (of documentary director) what advice would you give him/her?

Tim: I have been working in television for nearly thirty years. When I started out, I didn't have a specific idea of making science documentaries, despite having a science degree. In fact, over that time I made all sorts of television programmes - live events, sports, children's, entertainment, drama.

But then over the last ten years, I found myself making more and more documentaries and when the chance came up to make a film about science I jumped at it. And I've been working in science documentaries ever since.

I would recommend that someone starting out in TV who wants to make science films should probably first get work as a research runner at a TV production company. The BBC has work experience opportunities for instance. There are a few courses I might recommend too, for instance Imperial College London runs a master's degree in science communication which is well thought of. But don't feel that you have to start in science TV - you can learn the craft of television first, and then focus on science later.

Antigone: Your documentary deals with a very delicate and sensitive subject for society. I suppose you have a personal opinion on nuclear power. Did making this documentary change your mind? Or has it somehow strengthened your previous idea?

Tim: I started making this film ambivalent towards nuclear, probably slightly pro, as long as it was well managed and legislated. During the filming, I saw some of the pitfalls of the industry, and have become aware that the industry is often less than perfect, so it made me think that if we are to have this industry - and there is much debate about whether that should happen or not - then the only way to manage it is extremely carefully, and with a long term view.

Antigone: I can imagine that the hardest part in making this documentary has been the bureaucracy that you and the staff had to overcome in order to enter the nuclear power plant and make the recording. Have these rules limited your creativity and the message of the documentary? Does this often happen?

Tim: It took over two years for us to get the paperwork signed to get access to Sellafield to make the film. It first had to be agreed with the nuclear industry, and the British Home Office and British government. But once this was in place, Sellafield agreed that they would have no say over the editorial of the film - so we could tell the story we felt was important. But, having said that, we knew from the start that the story we were telling was not about the pros and cons of the nuclear industry, it was always about the science and history of the industry,

Antigone: *Inside Sellafield* has two strength points: it speaks of a hot topic people like to hear, and brings the

viewer into a secret place. In your opinion, what is the one that has most fascinated the public?

Tim: I think what made this film so successful was that it gave us a chance to see inside a place which has remained secret for so long. And that was made more significant given that what happened there was so important for all of us.

Antigone: This year, the March for Science was celebrated all over the world, a global event to make governments aware of the importance of science for societies. Do you believe that scientific documentaries also have this function? And do you believe a greater interaction of the science world with that of large-scale disclosure could facilitate the transmission of this message?

Tim: Science documentaries are a chance to show the best (and sometimes the worst) of the world of science to the general public. It is our duty as science communicators to make sure we do this as effectively as possible.

And as science becomes more and more specialised - and at the same time more and more at the heart of our society – it is critical that these kinds of messages get out. Science needs to communicate or it will become estranged from society.

Antigone: Did you imagine that the documentary would win the Physics Prize by the European Physical Society? In a world where the quality of a product is measured by the number of likes or visualizations, do you think an achievement like this is unflagging or can also have a value for the documentary distribution?

Tim: Certainly winning was a great surprise – it's a great honour to win, and I know all the team involved feel very pleased to have won such a prestigious award. I hope that the prize might bring about interest in the film and the subject to new audiences.

After this interview I watched the documentary for the third time. Once again I am amazed by the clearness of the scientific message. When Jim Al-Khalili has to explain how to trigger the chain reaction he shows a box with 120 loaded mousetraps, each with a ping pong ball on it. Dropping a single ball in on top of the box, one ball triggers more and more in the mousetrap, starting the chain reaction. That's how it works in a reactor. As each uranium atom splits, it also releases neutrons. And just like the ping-pong balls triggering the mousetraps, these neutrons could split new uranium atoms. The Uranium would trigger a massive nuclear chain reaction. Plus producing enough neutrons to turn some of the Uranium into Plutonium. Historically all this science was focused on the realization of nuclear bombs. But for nuclear physicists there's another way to use all this scientific knowledge. The same nuclear science that had split the atom to make a bomb has the potential to produce almost limitless cheap energy. Because in addition to producing Plutonium the reactor produced heat, and that heat could be harnessed. As Jim says, "The dream was that the power of the atom would come out of the shadow of the bomb, and into our living rooms…As electricity!". That is what happened in 1952 in Sellafield: work began on an ambitious experiment in power generation that would shape the modern world. It was called Calder Hall, opened in 1956. During the celebration the Queen said: "This new power which has proved itself to be a terrifying weapon of destruction is harnessed for the first time for the common good of our community". On 27th August 1956 heat generated from the nuclear chain reaction was used to turn water into steam that turned a turbine and made electricity. And that electricity was poured for into the National Grid, making Sellafield the world's first Nuclear Power station.

Unfortunately, the knowledge of physical processes such as those explained in this article can be used for war purposes. In times with a high tension between nuclear-armed states a clear message was given by the Norwegian Nobel Committee, which awarded Nobel Peace Prize to the International Campaign to Abolish Nuclear Weapons (ICAN) *"for its work to draw attention to the catastrophic humanitarian consequences of any use of nuclear weapons and for its ground-breaking efforts to achieve a treaty-based prohibition of such weapons"*.

Thirty years ago my country (Italy) chose with a referendum to abolish nuclear facilities. It was 1987, just one year after the Chernobyl accident. I was a child. I did not know I would study physics. I just remember that the YES won, and everyone was celebrating the result. I wonder how many Italians knew at that time the difference between alpha, beta and gamma particles. I do not think this number has changed so far. That's why a documentary like this one I'm talking about has a very strong social value. Because it explains nuclear, without demonizing or taking part. The spectator will then make his choice, pro or contra. But after the documentary his/her opinion will be supported by scientific information.

That is why we don't just have to do science, but also explain it. ■

About the Author

Antigone Marino is researcher at the Institute of Applied Sciences and Intelligent Systems of the Italian National Research Council in Naples, Italy. Her research activities are concentrated on the study of soft matter optic. Since 2016 she is jury member of the European Science TV and New Media Festival and Awards.