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SCIENCE STORY TELLING IN TV DOCUMENTARIES

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Abstract: *The three letters, DNA, have taken on a new meaning and significance over the past 60 years – not just in biology – but in everyday life. This paper analyzes a number of different approaches to unraveling stories about life sciences on television. Some are playful, some feature conflict, some pose riddles, some tackle big questions and some feature unusual timelines; but they all follow a strong narrative. Drawing on clips from films I have directed or produced that feature DNA as a theme, I will illustrate a variety of techniques (visual and structural) to television story telling. Finding the right narrative is critical to most documentaries, yet even more for films about science, because scientific topics can become dry and devoid of emotional engagement. There is no shortage of enthralling science stories to tell. The challenge is to find interesting ways to bringing them to life.*

Keywords: *science, television, popularization, documentary films, story-telling strategies*

Resum: *Les tres lletres que formen la paraula ADN han experimentat un canvi en el seu significat en els darrers seixanta anys, no només en biologia, sinó en la vida quotidiana. Aquest article analitza un conjunt de diferents estratègies per explicar històries sobre ciències de la vida a la televisió. Aquestes poden ser entretingudes, introduir conflictes, plantejar enigmes, abordar grans qüestions, o mostrar línies temporals inusuals; però totes segueixen una narrativa robusta. A partir de clips de pel·lícules que he dirigit o produït, il·lustro una varietat de tècniques (visuals i estructurals) per*

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explicar històries a la televisió. Trobar la narrativa adequada és clau en la majoria de documentals, i encara més en aquells que tracten sobre ciència, ja que els temes científics poden esdevenir àrids i mancats de lligams emocionals. Les històries sobre ciència apassionants no són escasses. El repte és trobar-les i trobar també formes interessants de donar-hi vida.

Paraules clau: *ciència, televisió, divulgació, documentals, estratègies narratives*

Introduction

The three letters, DNA, have taken on a new meaning and significance over the past 60 years. Across the fields of biology, medicine and forensic science the impact of this double stranded molecule with its simple, but life defining, four-letter code has been profound. Yet DNA has now entered the language and has come to mean something much broader. When we say something is in that company's DNA or that brand's DNA, we are referring to the fundamental and distinctive qualities that define that organization or object. Progress in the development of DNA science over the past six decades has been so rapid and extensive that the general public has an increasingly vague concept of what is at stake. This research has far-reaching social, economic, political and even cultural consequences; so there is a real need to communicate the science in an engaging way.

This paper describes and analyzes a number of ways of tackling stories about science in television documentaries. Some of these approaches are playful, some feature conflict, some pose riddles, and some tackle big questions. Drawing from clips of films I have made that focus on DNA-associated knowledge and technologies, I will try to illustrate a variety of strategies to science story telling on television. All these approaches, despite being very different, are aimed at creating and maintaining a strong narrative. Of course, finding the right narrative is a critical factor in most film and television story telling; however it is especially important for films about science, where the subject matter can seem dry, distant and devoid of emotional engagement. Building a strong narrative is a vital driver in producing inspirational and engaging films about science.

What follows is a distillation of the lecture I gave on May 16th, 2013 at the "7th European Spring School of History of Science and Popularization: Science on Television". The School (which took place in Maó, in Minorca, Spain) offered a rare opportunity to establish a fruitful and dynamic exchange between academic theorists, in this case historians of science focusing on science popularization issues, and media practitioners, who produce and direct television content.

The main motto of the School was "when theory meets practice". Theorists and practitioners rarely come together to discuss the media and its exploits. Both are wary of crossing the apparent gulf that exists between the two. It would seem that the production of films and television programs has somehow to be achieved without the meddling of academic

analysts because of their lack of experience in the actual craft. Correspondingly, it would seem that the media (in this case, film and television) practitioners have no say or interest in the analysis of their own work, because they are too preoccupied by the pressures of their trade to spend time reflecting on any deeper influences or consequences of their productions.

However, the School showed the unequivocal advantages of bringing together these two professional clusters. It proved to be an enriching experience, not only through the interaction between the academics and practitioners participating as professors, but also through the exchange with a critically engaged audience of students (among whom there were more academics and practitioners). Indeed, both groups showed that they could very well inform each other on many aspects of their respective professions.

Concerning narrative around science on television

With this in mind we are going to focus here on technical questions that are commonplace in the making of films, particularly documentaries, and above all with those having science content. In particular we will focus on the problem of finding the right narrative when dealing with scientific subject matter. But what do we mean by the *right* narrative? I will draw on my own experience in making films, particularly around DNA science and technology, to illustrate the many challenges to be confronted.

Producers attempting to convey scientific (or any kind of) knowledge to a mass audience have wrestled with a number of different techniques. Most practitioners try to fulfill the century-old dictum on the need to ***educate, inform and entertain*** (this dates back to a statement made in 1922 by David Sarnoff, then head of the Radio Corporation of America, RCA; but it was soon also adopted by John Reith, then General Manager of the BBC).[2] This well-known diktat seems to place *entertainment* in third place, which suggests how the priorities of mass audiovisual media were perceived in its early stages of development. Nevertheless, practical experience of trying to reach an audience in an industrial, market-driven society soon made it clear that there was a need to entertain in order for the medium to achieve the other goals. Much has been said about how entertainment can be achieved when the subject matter is complex scientific, medical or technological information. Scientists vary enormously in their reaction to this process. Some are determined to explain every nuance and qualification of their research and feel affronted if there is too much over-simplification. Some despair at misconceptions and misinterpretations of data. Others are grateful that there is interest in their research at all and go out of their way to help. They understand the need to engage the public in an entertaining, informative way.

It is easy to appreciate how science can be misrepresented in popular media. Sometimes when there are disagreements between scientists, the controversies are glossed over to sim-

2. <http://www.bbc.co.uk/historyofthebbc/resources/in-depth/reith_5.shtml>

plify the message. At other times the sparks of controversy are fanned into an inferno that generates more heat than light. But increasingly an understanding has been reached that science is not an activity that can be conducted in private solely for publication and discussion in academic journals. To obtain funding, appreciation and sympathy for science, scientists realize they need to engage the public through mass media. In many institutions this is now part of their job description. So things have moved on since the days when scientists complained about the trivialization of science. Nowadays, they are much more likely to appreciate the need to get across key messages and their chief concern is the lack of science coverage on television.

Today scientists sometimes collaborate closely with science filmmakers to help tease out the most imaginative and dramatic way of presenting their science. For instance, on our recent *Your Inner Fish* series (2014, see below), we were in constant dialogue with scientists throughout pre-production and post-production to ensure the accurate portrayal of their work. When we depicted fossils and extinct animals in CGI sequences, scientists checked to make sure they were accurate in every anatomical detail. Scripts were discussed at length with Neil Shubin[3] and a team of scientific advisors at various stages of production, right through to the final recording of the narration. Increasingly, this spirit of collaboration and inclusion in the film making process is built into the production of major science documentaries. Obviously on more fast-turnaround shows and TV news stories there are different pressures and no time for such a dialogue. But overall, scientists tend to be more sympathetic to the challenges faced by the filmmaker than they used to be, even if pressures on their own time mean they cannot always offer extensive help.

Looking at how science can be turned into a strong, successful narrative, there are few better places to begin than with Jim Watson's account of the discovery of DNA in his best-selling book *The Double Helix* (1968). This is deservedly seen as a classic of science story telling. Leaving aside its historiographical limitations, Watson demonstrated that a potentially dull scientific piece of information (the analysis and interpretation of X-ray crystallographic data) could be turned into a human story infused with competition, jealousy, espionage and drama. It is in the end a very personal narrative – an account of DNA's central part in his life – that reflects his mischievous persona. His strongly flavored opinions about his colleagues and his indiscreet comments about their motivation and success shocked many scientists when it was first published. But it is that personal, undiluted honesty that makes it such an engrossing tale (Watson originally wanted to call the book *Honest Jim*).

To attract a broad audience to scientific endeavors, it is more engaging if you can bring a personal lens to the story. By doing this, the narrative unfolds against a background of shared human experience and emotional force that is common to most human activities beyond the confines of the lab. This is not to say that the science should be ignored, rather

3. <http://pondside.uchicago.edu/oba/faculty/shubin_n.html>

that the audience is more likely to be motivated to take an interest in a subject that we can see has captured the imagination of a researcher. There is a common misconception that the only way to reach a mass audience is to 'dumb down' and trivialize the science. TV shows that do this underestimate the intelligence of the audience. My philosophy is that you can get across a lot of interesting scientific information once you have engaged the audience in the characters at the heart of the story. Even in this paper I will thread elements of my own personal story to add a secondary narrative thread that sets the ideas into a chronological context.

By some serendipitous means, DNA has always played a big part in my life. To begin with, I was born the same year and month that Watson and Crick celebrated the discovery of DNA's double helix structure (Watson & Crick, 1953). Later on, at college, I read Watson's classic textbook *Molecular Biology of the Gene* (1965), and was completely enthralled by its clarity and brilliance. And gradually my early fascination with the twin threads that define DNA's structure was carried over into my professional work as a film and television producer and director. Indeed, one of the first films I directed was about the revolution in DNA science (*A License to Breed Money*, 1981). It featured the birth of a new start-up called Genentech[4] – one of the first genetic engineering companies - that today is a massively successful pharmaceutical company with its own campus and gigantic manufacturing facility.

Of course, not all my films have a connection to DNA; but nevertheless over my film-making career the molecular science of life is something I have returned to again and again, either directly or indirectly. So for the purposes of this paper I have focused on these films to explore the contrasting visual and structural techniques I have used to create a compelling narrative. What follows is an account of what I have learned over thirty-five years of making science documentaries, using clips from my films. Hopefully, it will encourage others to develop new and original ways of telling these important stories. There is no shortage of fascinating science stories to tell. The challenge is to find interesting ways of bringing them to life.

The Examples

Whether it's a feature length documentary or a one-minute short, the challenge facing a filmmaker is to develop a narrative that works. One classic way of doing that is to have a riddle or a mystery that is not resolved until the end. The first example of this technique is from a series of very short one minute films produced for the BBC's Science Week around twenty years ago. Yet they still stand up as intriguing little puzzles. The series of films was called *Conundrum* (1995). The idea was to describe something familiar in a very unfamiliar way using scientific language to define and describe the object. It's like a recipe where you reveal the ingredients of a dish without naming the dish until the end. Or imagine writing

4. <http://www.gene.com/media/company-information>

a patent for an object– while keeping the identity of the object hidden till the final frame. For instance, in a single continuous motion control shot that flies over a series of objects and actions illustrating a combination of chemical elements; then they are mixed together and 'baked'; and then in the final frame the lid of the cooking pot is lifted to reveal a baby.[5] The recipe was a precise breakdown of the percentage of each chemical element found in the human body. And the moment when the lid is lifted is quite a surprise the first time you see it. This one-minute film is an example in miniature of how a classic story unfolds: first you tantalize the audience, then you intrigue them as the story evolves, and finally you resolve the story with a dramatic pay-off. This can be summarized in three steps: **tantalize, evolve, resolve**.

I should say that I do not like being too prescriptive about story-telling. I have always been slightly wary of the highly popular story-telling seminars attended by a generation of science producers in recent years, because I think it can lead to formulaic storytelling and thinking. Sometimes quirks and diversions can enrich a story. Nevertheless, a film is a linear construction and there are some useful lessons to share in constructing documentaries about science.

One of the least satisfying forms of science documentary is the survey film, where you take a subject and then try to assemble a set of modules that give an overview of the subject. There is a surprising number of these films – and with some notable exceptions – most of them are very forgettable. They deliver clear information, but lack any emotional involvement or story, so they fall flat.

Sometimes you see exciting developments in an area of science and technology – and you want to capture the buzz of that revolution. A good way of doing that is to carry out a wide trawl and then identify a place to dig deeply. The result can be a more profound insight into the bigger story. Back in the 1980s, the editor of the BBC's flagship science series, *Horizon*, was eager to commission films about the huge implications of genetic engineering and DNA science. So with this in mind, two young producers (Oliver Morse and myself) set off on a grand tour of the most important labs in the USA and Europe. We took a crash course in molecular biology. We came back excited by what we had found out – but completely overwhelmed. It was a daunting task to identify any narrative in what we had experienced. The science was extremely tough to explain and in the immediate future the consequences seemed quite remote from people's lives. It really focused our minds on what would make a good story. DNA science is intangible stuff – remote from most people's experience. So how could we engage an audience? In the end we proposed two very different films: *The Cline Affair* (1982) and *Brave New Babies?* (1982). Both were broadcast in the early 1980s and both very much reflected the uncertainties of the time.

5. <http://vimeo.com/108993642>. A second example *(Clarinet)* of the same technique is shown in this clip.

The Cline Affair (BBC *Horizon*, 1982)[6]

Science can be a heroic pursuit, but like any other human endeavor it is prone to human frailties and ambition. There was a lot of suspicion about the wisdom of genetic engineering thirty years ago, so to carry out an experimental treatment using recombinant DNA was highly controversial, particularly when it was done without the full informed consent of patients. *The Cline Affair* was a moral tale that provided an indirect, but compelling way into what was possible with the new recombinant DNA technology.

This film has a strong narrative structure. It begins by drawing you in to this character – Dr. Martin Cline, a highly ambitious and brilliant UCLA physician – and then it teases you with the fact that he has done something wrong, something deceitful, something that will almost destroy his career. So there is tension from the start – and the viewer will be judging this man's actions.[7] This provides a motivation to follow the story and offers something that is quite rare in films about science – dramatic tension. Yet to appreciate the twists and turns of this story – you need to understand the principles of the science portrayed. Consequently there's lots of science in this film: from the role of globin genes, to the use of genetically engineered bone marrow stem cells to treat Thalassemia. But the science is only introduced at the point in the story when you need it to judge the moral dilemma facing this man. This stealthy drip-feeding of science allows the viewer to become absorbed in the story and not feel they are watching an educational film. Only scientific explanation that is essential to propel the narrative forward is included. If you are trying to make an informed judgment about this physician, then this is vital. Gradually, you shift from feeling his actions are justified to feeling he has over-stepped the mark. There is no clear-cut right or wrong – and that's what keeps the drama of Dr. Cline's situation interesting. You can feel his frustration and see his dilemma. What drives this film is not the science, but the tragedy of a man embroiled in his emotive reaction to the science. The art of this kind of story-telling is to make the audience see the world through his eyes, so they can judge for themselves his motives. He felt, given the terrible nature of this devastating genetic disease, he was justified in going ahead with his recombinant DNA treatment. But do you believe his motivation? Does the end justify the means? As you hear his justification you feel a mixture of empathy and outrage – and so, there is ambiguity to the end.

Brave new Babies? (BBC *Horizon*, 1982)[8]

The Cline Affair had a natural narrative. The second film about the rights and wrongs of genetic engineering, *Brave new Babies?*, was more didactic. It was built around the musings of a moral philosopher called Jonathan Glover[9] who set out to investigate the subject. His

6. <http://collections-search.bfi.org.uk/web/Details/ChoiceFilmWorks/150107896>
7. <http://vimeo.com/108993864>
8. <http://www.worldcat.org/title/brave-new-babies/oclc/66796464?referer=di&ht=edition>
9. <http://www.jonathanglover.co.uk/>

journey provides the framework for the film. He visits scientists, families and other people whose lives might be affected by the new technology. The difficulty with using these encounters as an underlying structure is that you are stuck with the chronology of the order of characters he visits. So the arguments need to be well prepared.

As so often happens in making documentaries, serendipity plays a part too. On the first day of filming we stumbled into an amazing scene – that we knew was something extraordinary. After breakfast Jonathan's children were engaging their father in exactly the kind of debate that was dividing people's views on genetic engineering. So we started filming. Their discourse became a continuing thread through the film.[10] The older of the two brothers, Daniel, aged 11, was pro-genetic engineering and thought that parents should have the right to choose the characteristics of their children; while the younger brother, David, aged 8, thought tampering with nature in this way was wrong. Here were the philosopher's children discussing DNA – their own genes and upbringing shining through.[11]

Wanted: Butch Cassidy & The Sundance Kid (NOVA/Channel 4 True Stories, 1993)[12]

DNA continued as a connecting thread in my films sometimes appearing in the most unlikely places. As DNA finger printing evolved it became more widely used in forensic investigations. It also became an investigative tool in historical documentaries. In 1993 I made a film called ***Wanted: Butch Cassidy & The Sundance Kid*** that followed in the footsteps of the two legendary outlaws to find out what really happened to them. Forensic anthropologist, Clyde Snow, led a team of scientists down to Bolivia to try to locate the graves of the outlaws, exhume their bodies and extract DNA from the bones. The film triggered a new genre of scientific adventure stories in the 1990s that traveled to exotic places with a mission to find something out.

The narrative of this film has two complementary threads that are carefully woven together. The first is the original story of the outlaws. This was told using Clyde Snow and outlaw historian, Dan Buck[13], as surrogate Butch & Sundance figures, who have a rapport and sense of humor echoing the characters played by Paul Newman and Robert Redford in the original movie[14]. The second is the archaeological and scientific investigation led by Clyde Snow.

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10. <http://vimeo.com/108994823>, 00:00 to 03:16.

11. Twenty years later David Glover would work with me on a series to celebrate the 50th anniversary of the discovery of the DNA (see below in the paper) and would then go on to become Commissioning Editor for Science at Channel Four (2005). See: <http://www.broadcastnow.co.uk/news/commissioning-old/david-glover-channel-4/5004646.article>

12. <http://www.windfallfilms.com/show/1222/Wanted+Butch+Cassidy+and+The+Sundance+Kid+.aspx>

13. <http://theappendix.net/contributors/profile/daniel-buck>

14. *Butch Cassidy & The Sundance Kid* (George Roy Hill, 1969). <http://www.imdb.com/title/tt0064115/>

He narrates the film as a personal odyssey in his distinctive Oklahoma drawl. A motion control rostrum shot tracking over various personal possessions and old photographs suggests Clyde's colorful past and credentials.[15] As the dig in Bolivia progresses and they dig up 'gringo' bones, the scientific investigation begins. Clyde calls together a group of experts to assess the evidence in a classic Sherlock Holmes de-brief. The narrative is told in the style of a Western and a detective story, yet their analysis reveals more about the scientific method in action than any film I have made. This is a film that contains a huge amount of science – but again, it is introduced almost by stealth at points in the story where it is needed to solve the mystery. There is never any sense of a 'science lesson'. I never assume the viewer is interested in science per se. I try to show how science can help answer interesting questions – a necessary tool for the curious.

Ten years on and DNA reared its head again as we drew near the 50th anniversary of the discovery of the Double Helix in 2003. I then approached PBS and Channel 4 to see if they wanted a series that celebrated the extraordinary progress of DNA science over the last 50 years. A lot had happened in the 20 years since we had filmed the young David Glover on the sofa discussing the pros and cons of genetic engineering. Now David was a young, talented filmmaker himself and he worked on what would become an Emmy-award-winning series, called simply, *DNA*. Now the challenge was even more daunting - to pick the right stories to tell in this epic saga.

DNA (Channel 4/PBS, 2003)[16]

The hero of our series was a molecule. Was that possible? Up to a point. But to appreciate that hero we also needed to identify key characters and stories. Much like this paper, I decided to adopt a chronological approach. It is the classic narrative structure. Each film was to be a distinct chapter covering a specific theme. We also wanted to have key characters appearing in several films – and the obvious central character was Jim Watson, who remained at the centre of DNA science all the way through. The first film looked at the original discovery, the second at the advent of genetic engineering, the third at the human genome project, the fourth at DNA's impact on cancer research, and the final program was Jim Watson's vision of the future of DNA.

The story of the discovery of the double helix is well-trodden ground. There's the book[17], the drama, *Life Story* (1987)[18], and many documentaries about this famous event. Our approach was to take Jim Watson back to Cambridge and to King's College, London. In the first film, *The Secret of Life*, we see him sit in the lecture theatre where he had sat 50 years

15. <http://vimeo.com/108997683>
16. <http://www.windfallfilms.com/show/1117/DNA.aspx>
17. *The double helix* (Watson, 1968).
18. *Life story* (BBC, Mick Jackson, 1987). <http://www.imdb.com/title/tt0093815/>

before, listening to Rosalind Franklin's X ray crystallography results – and where he was shown the infamous photographs by Maurice Wilkins. It's an intimate film following an old man reassessing the most important moment in his life.

In the second film about the birth of genetic engineering, *Playing God*, we look back at the public concerns about the potential dangers of recombinant DNA. In 1975 a group of scientists, lawyers and physicians got together at the Asilomar Conference in California to discuss what should be done. Again, we took back key participants, Paul Berg and Jim Watson, to the conference centre on Asilomar State Beach to re-live the debate. Taking people back to the scene of an important event in their lives often works well in documentaries. It helps jog memories and also provides a visual backdrop to evoke the history of that time.

In this second film, we also wanted to show the incredible progress of genetic engineering in recent years - to bring the film completely up to date. We needed some way of encapsulating the way this lab bench science had turned into a massive industry. The scale of modern plants, like the manufacturing facility at Genentech in Vacaville is jaw dropping.

But how do you encapsulate this in a short sequence? The art of compression and distillation is vital in such circumstances. When we arrived to film, we were presented with their Head of Manufacturing, who had a limited amount of time and was expecting to give a short interview with a stainless steel vat as a backdrop. We were after something much more ambitious – which gave an idea of the enormous scale of the place. So I suggested he take us on a lightning tour of the facility. We would put the camera on a dolly and chase after him, keeping the camera rolling all the time, and then he could go back to work. He begins at the entrance by saying: "Welcome to Genentech!" and then we set off on this journey with running commentary round the plant, chasing him along corridors, into elevators and through vast warehouses and manufacturing plants. In the final edited sequence which is compressed, but continuous, we crank up the scene in fast-forward, selecting only key bits of his commentary and slowing down only for short bursts of sync sound.[19] The result is a highly energetic whistle-stop tour of the facility – a very short sequence that encapsulates the scaling up and production of a genetically engineered drug.

The third film, *The Human Race*, focused on the race to sequence the Human Genome. The use of a race between two rival research groups is a familiar narrative structure in science films. In this case it was a race between two different philosophies as well – the publicly funded group, led initially by Jim Watson, and then Francis Collins with John Salston; and the privately funded group led by scientist and entrepreneur Craig Venter. This battle between the public and private groups became so bitter that President Clinton had to intervene as a peacemaker.

Finding pictures to support dramatic stories from the past always poses problems for documentary makers. In this film about the human genome project we had virtually no

19. <http://vimeo.com/108997883>

archive pictures – and most of the crucial research work was data crunching on computers. (There are only so many sequencing machines you can show.) We liked the story of the 'hippy' programmer in California taking a break from more lucrative gaming programming, to help number crunch the data from both sides of the Atlantic – working late into the night in his shed. To visualize this we used Super-8 film with a heavily saturated color grade to give a slightly 'acid trip' tone to his nocturnal antics.[20] But the real challenge in the story telling was to explain what the scientists were doing.

In order to appreciate the enormity of the task of piecing together millions of fragments of DNA into the complete human genome, we needed to use CGI. Integrating graphics into science films is hard to do without making the film feel educational. If it is badly done, it can upset the tone of the story telling, but sometimes ideas are so complex, graphics are the only way. This was going to be a problem throughout this series, so we built a set – a stage on which all the CGI for all the films would play out. The set was a 1950's lab, which is used in the first film as a backdrop for illustrating base pairing in the double helix; in the second film for showing recombinant DNA, and in the third film for demonstrating the huge amount of data generated to read the four-letter code of the entire human genome. We used huge piles of paper that were stacked impossibly high into vertical space above the lab bench and explosions that shattered the papers into tiny fragments. The use of the lab set as a backdrop for all explanatory graphics became a defining device of the series and helped maintain the narrative integrity throughout.[21]

In the final film of the *DNA* series, *Pandora's Box*, we follow Jim Watson on a more personal journey to consider the future of DNA, against an emotive backdrop of eugenics, genetic testing and gene therapy. At the beginning of the film we capture the essence of Jim Watson's controversial character – the devilish delight he takes in challenging orthodox views. This sets up a remarkable personal odyssey in which he confronts some of the questions and concerns that DNA science raises about the future of humanity. In many ways this was the most difficult narrative to construct, because there is no natural chronology, yet it ends up being the most emotionally powerful of the films. You travel with this much-misunderstood man, who made one of the most important scientific discoveries of all time and discover what he thinks. The molecule – DNA – sits at the centre of all the arguments. Yet, following an individual on an odyssey is another powerful story-telling device, particularly when they are asking a big question and set off on a mission to answer it.

20. <http://vimeo.com/109000198>

21. <http://vimeo.com/109001864>

Do You Want To Live Forever? (Channel 4, 2007)[22]

In '*Do You Want To Live Forever?*', computer scientist, Aubrey de Grey has a passionate belief that biological science may be able to save us from getting old. Most scientists remain skeptical, but the quest to find out whether he is inspired or deluded forms the basis of an eccentric road movie directed by Christopher Sykes that delves into this character's psyche. We first meet Aubrey in the Eagle, in Cambridge, the pub where Watson and Crick celebrated their double helix discovery. From this initial introduction you feel uncertain about whether to believe this man – but this is a crucial part of the film's underlying dramatic tension.

The pre-title 'tease' at the start of the film is a great example of an enticing introduction – which sets up the proposition perfectly and introduces an eclectic cast of characters.[23] During the course of Aubrey de Grey's journey, he meets scientists and technologists from many different disciplines that give the viewer an intriguing insight into the science of ageing. Aubrey wants to bring these people together in the hope of cross-fertilizing ideas that might mean that science can halt the ageing process. Many scientists view Audrey as a heretic, but as the film progresses you want to know what drives his mission. Why is he so desperate to find the elixir of life? The film has a wonderful 'Rosebud' ending where you discover the final piece in the jigsaw of what might motivate Aubrey in his quest for eternal life. The suggestion is that it was a love story all along – and that the driving force behind his passion is his partner, who is older than him. He wants her to live forever, like him. This is a quirky film, but it does offer an insight into the current state of scientific understanding of ageing in a non-didactic way. It is a film with emotional undertones that make you laugh and cry as the narrative unfolds.

Your Inner Fish (PBS/Tangled Bank Studios, 2014)[24]

Some of the most difficult stories to construct are based around a high concept idea with no obvious linear narrative and lots of potentially diversionary back-stories. This was the case with my most recent science series, based on a book by Neil Shubin[25], called *Your Inner Fish* (2008). The idea is to trace parts of your body back to your ancient animal ancestors – 'meeting the family you never knew you had.' To do this, the film draws on paleontology, developmental biology, comparative anatomy and DNA science to find links with our past. This was a highly ambitious series that tested story telling to the limit. The series was broadcasted on PBS in 2014 and had three parts: *Your Inner Fish*, *Your Inner Reptile* and *Your Inner Monkey*.

22. <http://topdocumentaryfilms.com/do-you-want-to-live-forever/>.
23. <http://vimeo.com/109004589>
24. <http://www.pbs.org/your-inner-fish/home/>.
25. <http://pondside.uchicago.edu/oba/faculty/shubin_n.html>

Unlike a book, which is conveniently divided into chapters, film is a relentlessly linear medium. There were several components to this story: an expedition to the Arctic in which Neil Shubin discovered a transitional fossil fish called *Tiktaalik*, one of the earliest fish to do 'push-ups' on to land; an evolutionary development story illustrating the DNA links between fins and limbs; and the human anatomy story that compares the bone structure of our hands to the fins of fish.

This is essentially an evolutionary biology tale, but to tell it chronologically would not be very interesting. In this case I wanted to take advantage of the rather surreal idea that there is an inner fish within us all; and that the evidence for this is in our bones and our DNA. I also wanted to give the series a setting – which in this case was the city of Chicago, where Neil Shubin works. The opening of the film begins on a Chicago subway train with Neil looking at his fellow passengers as they transform into a monkey, a reptile and a fish. In the reflection of the train window he sees the Tree of Life unfolding. Immediately we are inside Neil Subin's head and it is a quite funny place to be.[26] I wanted to reflect his humor in the films. You want to be with this man and hear his stories. His passion and intensity shine through and that's what draws you into the difficult subject matter.

One of the first scenes takes place in the dissection room of the Chicago Medical School where he teaches. He tells the story of the first time he dissected a human hand. It is a surprisingly poignant moment, which transforms into a sequence about hand anatomy. Immediately you are presented with the riddle of how the human hand evolved from the fins of fish. There are several quirky scenes, such as 'My wife's a fish' – a scene where Neil calls in on a neighbor who shows him the remnants of a gill structure behind her ear. These comic interludes have a serious purpose – to demonstrate the developmental processes that can occasionally reflect vestigial bits of anatomy from our 'fishy past'.

As well as being an anatomist and developmental biologist, Neil is a fish paleontologist. One of the major strands through the film is his search for this transitional fish fossil that made it on to land. We took him back to the Canadian Arctic where he found this fossil, but rather than run this as one complete story, in the final film we kept returning to it, culminating with the actual discovery of *Tiktaalik*. This helped build up to the climax of the discovery, but it also allowed us to integrate the second 'evo-devo' strand through the film. The film culminates with an epic CGI sequence in which we see a series of embryonic creatures gradually making the transition from fish fin to human hand that draws the two strands of the narrative together.

26. <http://vimeo.com/109002768>

Conclusion

I've looked back at some of the story-telling approaches that have worked for my films – and in doing this I've constructed a narrative that has DNA at its heart. Twin strands have been a recurring theme throughout. I'm drawn by the aesthetic appeal of the double helical structure of life, and by examining the underlying structure of these films that share DNA in different ways I've tried to demonstrate some of the story-telling techniques I've used in the past.

These techniques include: the classic scientific detective story, using a moral dilemma as a sub-plot; a race to be the first to discover something; a personal odyssey driven by a central character; and a riddle or mystery that is only resolved at the very end of the film. For each of these approaches finding characters that display conviction, passion and a sense of humor is often crucial to the success of the film. Then the challenge is to identify a narrative structure that suits the subject matter and reflects the character of the participants.

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