Science documentaries and their coordinates

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This article focuses on some fundamental axis of the science documentary from a multiple perspective. Firstly, it attempts to draw the limits of this subgenre by means of some of its most common characteristics, such as the direct connection to findings of scientific research and the presence or support of scientists. Secondly, a brief historical review is undertaken, focusing on some of the pioneers who made a decisive contribution to conform it. Finally, it presents some key trends that help to define the present situation, including the search for entertainment and trends resulting from the use of digital technology.

Keywords

Science documentary, concept, history, market, current trends.

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A subgenre of imprecise limits

It is no easy task to precisely delimit the terrain of the science documentary, as many different forms, objectives and target viewers can be distinguished. Sometimes, the documentary is constructed with images recorded during the research processes themselves, while at other times material is used that has been recorded *ex profeso*. Some documentaries are conceived as an instrument of communication between specialists, while others are aimed at the public at large. Some have the prime objective of informing, while others educate and some entertain their audience.

Neither should we forget that all documentaries ultimately have some connection, more or less direct, with some scientific discipline, as all present knowledge or facts that, in one way or another, have been investigated by some branch of science.

However, apart from this variety, it seems evident that TV channels have scheduling timebands labelled as “science documentary”, where programmes are included on astrophysics, nature or medicine, just to name a few frequent examples. These usually include programmes tackling issues that have been specifically studied by some scientific discipline, normally highlighted by the presence of the researchers themselves in the documentary and sometimes by including images obtained during the actual research.

In principle, we could demand that the structure and basic approaches of scientific documentaries be somewhat in line with scientific method. However, we mustn’t forget that science is popularised by the audiovisual media “through a kind of peculiar statement, the means and purposes of which are not necessarily scientific” (León 1999, 180).

This approach coincides with that expressed by other authors, who point out that the popularising discourse is not usually a mere *translation* of a scientific text into language

that is easily accessible for the public at large, but is rather the creation of a new thing, with its own being, characteristics and purposes (Roqueplo 1983, 114). By means of this new statement, it's possible to create the necessary link between discourse that is "specialised and general discourse, oral and written, empirical and phenomenological [...]; in short, between science and common sense" (Silverstone 1986, 81).

Bringing together these ideas, we may consider the science documentary to be a subgenre that includes audiovisual works meeting two requirements (León [et al.] 2007):
1. They deal with the subject by focusing on the findings of research, facts or knowledge related directly to some discipline of science or some argumentation based on scientific knowledge, including natural, applied and social sciences.
2. They explicitly show (in the image, narration or credits) that they have had the collaboration or support of scientific experts or institutions, which have taken part as sources of information or advisors on content.

These characteristics allow us to identify a kind of production that forms part of the history of cinema since its very beginning. The work of these pioneers, which we will review briefly but by no means exhaustively below, allows us to establish some fundamental coordinates, as their approaches have guided the development of the science documentary up to the present day in terms of the issues dealt with and the underlying approaches.

The contribution of some pioneers

Cinema and science have been closely related since the very first film crews appeared at the end of the 19th century. On the one hand, cinema finds sufficiently interesting reasons in science to transfer it to the big screen. On the other, scientists employ the moving image as a research tool because it allows them to observe those natural phenomena that occur too rapidly or too slowly to be appreciated by the naked eye.

Medicine was one of the first disciplines to turn to cinema. In 1896, only one year after the Lumière brothers presented their cinematograph, this invention was used in Russia to film various surgical operations. As from the following year, the Pole Boleslaw Matuszewski, a cinematograph operator, also filmed several operations. In 1898 in Great Britain, Dr. Panchen made three films on different illnesses.

Animals and their behaviour have been filmed since the start of cinema. According to Bousé (2000, 44), the first animal film of which we have evidence is entitled *The sea lion's home* (1897), filmed by Edison. According to this author, from that time on two traditions co-existed within this area of documentary, developed respectively in Europe and in North America. The European tradition attempts to film the behaviour of creatures in their own habitat and tries to make sure that the filming process does not interfere with them. The North American tradition, on the other hand, particularly aims for spectacular images, which often leads it to film situations set up for the camera.

Apart from serving as an instrument for scientific research, cinema has also been used as a means of popularising science since its early days. The first outstanding attempt was made in England by the firm Urban Trading, founded by Charles Urban. Among its first productions are some brief films with microscopic images, such as *Circulation of the Blood in the Frog's Foot* (1903), which would later form a part of a series entitled *Unseen World*.

In France the same year, Dr. Jean Comandon made for Pathé *La vie microscopique dans un étang* ("Microscopic life in a lake", 1903), considered to be the first biological film. The aim of this film was to "demonstrate to his colleagues certain phenomena of very short duration, to delineate experiments or devote himself to the general observation of things, beings or facts" (Calvo Hernando 1977, 270). In 1909 he filmed, for the first time, the organism that causes syphilis (*Spirochaeta pallida*), and sent the material to the Science Academy in Paris as part of his doctoral thesis. But scientific films were also being made in other countries. For example, in 1904 the Italian R. Omega filmed the different phases of a butterfly's metamorphosis.

As from that time, the cinema of scientific popularisation started to occupy a certain space in some of the news reels or shorts that preceded the fictional feature films shown at cinemas, or as a complement to other shows. A large number of them dealt with areas of human science, especially travelogues, as well as natural sciences. The film by Oliver Pike, entitled *In Birdland*, was premiered at the Palace Theatre in London in 1907. At that time, it appears that the

public of the British capital was already used to seeing films with this kind of content at the end of music hall shows (Bousé 2000, 45).

Animated films provide scientific and popularising documentaries with many possibilities. One of the earliest experiences in this area can be found in the film by Émile Cohl *Joyeux Microbes* ("Lively microbes", 1908) and later, also using animation, Atlantic Films produced the series *Trois Minutes* ("Three minutes"). At the start of the twenties, one of these short films, entitled *Trois Minutes d'astronomie* ("Three minutes of astronomy", 1934), reproduced the speeded up movement of the planets and the moon. The same technique was used by Étienne Lallier to popularise the theory of relativity. This series was recognised as an example of scientific cinema, for its inventiveness and its great capacity to transmit knowledge to the layman.

In France, at the beginning of the 1910s, an interesting rivalry arose in the production of informative documentaries between the companies Eclair, Pathé and Gaumont. In 1911, Eclair launched a series *Scientia*, while Pathé, since the previous year, had included a line of films in its catalogue made under the supervision of Jean Comandon, which were called "of scenes of scientific popularisation" (*scènes de vulgarisation scientifique*). For its part, during the same period Gaumont launched a project entitled *Encyclopédie*, which included films on new scientific disciplines and was notably successful. These films can be clearly distinguished from those made by scientists as a means of research, as they have a different end purpose, distribution circuits and narrative forms. In the case of popularising films, the importance of "editing and didactics" can already be seen (Gaycken 2002, 354).

In Spain, there is evidence that cinema was also used in the same decade as a means of scientific research. In 1915, the ophthalmologist Ignasi Barraquer presented various films at the Hospital Clínic in Barcelona made by Francisco Puigvert on surgical operations for cataracts. At the same time, Antonio P. Tramullas recorded the research of Dr. Rocasolano on the mobility of silver micelles, using the camera as a microscope (Álvarez 1996).

At the end of the twenties, Frenchman Jean Painlevé produced his first work, mostly cinematographic experiments on underwater life in which he used advanced production techniques, such as high speed filming and slow and fast motion, which would be widely used in the years following. His first works are *Le pieuvre* ("The octopus", 1928), *Oeufs d'Épinoche* ("Stickleback eggs", 1928), *Les oursins* ("Sea urchins", 1928) and *L'Hippocampe* ("The sea horse", 1934). Later on he made films on the lives of great French scientists, such as Paul Langevin, Jean Perrin, Louis Loumière and Louis de Broglie, among others. One of Painlevé's main successes was applying the spirit of avant-garde artists to scientific cinema, which brought him enthusiastic comments from the artists of the time. For example, Fernand Léger said of his film *Caprella et Pantopoda* ("Caprella and Pantopoda", 1930) that it was the most beautiful ballet he had ever seen, and Marc Chagall referred to its "incomparable plastic beauty" (Bellows [et al.] 2000, 19).

As from the thirties, a large number of zoological studies no longer focused on the taxonomic work of previous years but dedicated themselves fundamentally to attempting to explain the behaviour of living beings. As a consequence, interest grew in cinema for scientists and the number of films multiplied. In Germany, the production company UFA created a scientific cinema section, led by Dr. Ulrich Schultz. Among the films produced by this section were particularly *Im Paradies der Vögel* ("In the paradise of birds", 1935) and *Die Stärke der Pflanzen* ("The strength of plants", 1935). In this last film, the technique was used of accelerating the plants' movement so that the human eye could perceive it. On the use of this resource, reviewers of the time wrote the following: "The extraordinary admiration the viewer feels is due to the fact that cinema appears as a magical instrument, miraculous, by the grace of which the most profound mysteries of nature are revealed" (Raichavarg and Jacques 1991, 197). This technique would be widely used in subsequent years.

In 1932, the first films by Dr. Guillermo Fernández Zúñiga were shown at the International Entomology Congress held in Madrid. These focused on the behaviour of bees and ants, whose filming had employed artificial hives and colonies designed and constructed by hand. Later on, Zúñiga directed more than twenty films on different scientific subjects, many of them shown in cinemas before the fictional feature film. Some won leading prizes at international events, such as the best short awarded by the Association of Cinematographic Reporters of Argentina in

1951. In 1966, Zúñiga founded the Spanish Scientific Cinema Association and is considered to be the pioneer and master of audiovisual popularisation (Álvarez 1996).

Documentaries with scientific content acquired greater relevance when television consolidated its position as a popular medium, as from the fifties. Among the extensive production of scientific documentaries made in various countries, of note is the British series *Horizon*, which the BBC started to broadcast in 1964 and which is still broadcast today, becoming an international benchmark for quality in scientific documentaries. Since the start of the nineties, *Horizon* has developed its own narrative form, in which the link between the issues being covered with viewers' lives is extremely important. This style has brought it great international renown, numerous awards and good audience figures.

Continuing with the British public channel, we can also note the production of nature documentaries, which started in the fifties. Among the leading authors is presenter and writer David Attenborough, considered to be one of the most important popularisers of our time. His successful career is based on several series of great length, from *Life on Earth* (1979) to *Life in Cold Blood* (2008). All strike an appropriate balance between television values and scientific rigour.

Inspired by the *Horizon* model, Michael Ambrosino created the series *Nova*, which was first broadcast in 1974 on the North American public channel PBS. Produced by WGBH in Boston, it is still being broadcast and has won the most important international prizes, becoming a model of quality popularisation. It stands out for its pace, clarity of narration and the originality of its scripts. Among many award-winning documentaries we can note, for example, *The Miracle of Life* (1983), *Spy Machines* (1987) and *The Elegant Universe* (2003), which have been broadcast in more than a hundred countries.

Another leading North American producer is the National Geographic Society, which was already making films about scientific expeditions at the start of the last century and has enhanced its production line of scientific documentaries as from 1961. Its documentaries were broadcast regularly on the CBS channel as from 1964, afterwards going on to ABC in 1973 and on PBS since 1975. National Geographic's productions are characterised by their particularly spectacular images, often possible thanks to innovative technological developments and sophisticated production systems.

In France, of note was the work by Jacques-Yves Cousteau, who made a large number of films from the forties up to his death in 1997. His first short films on underwater life are *Par dix-huit métres de fond* ("At eighteen metres deep", 1943) and *Épaves* ("Remains", 1945). His first great international success came with the feature film, in colour, entitled *Le monde du silence* ("The world of silence", 1956). Cousteau went on to achieve more success with *Le monde sans soleil* ("The world without sun", 1965), *Experience precontinent III* ("The World of Jacques-Yves Cousteau", 1965), and *Voyage au bout du monde* ("Voyage to the end of the world", 1975).

Cousteau also produced a large number of documentaries for television. Among the distinctions and awards obtained over the years there are three Oscars from the Hollywood Academy and the Palme d'Or from the Cannes Festival. For over half a century, Cousteau made numerous explorative expeditions on land and seas around the planet. From his recordings, documentaries have emerged that are broadcast on television channels the world over, today the symbol and prototypes of the most exciting ecological audiovisuals programme.

In Spain, of note is the work by Félix Rodríguez de la Fuente, considered to be the most important populariser of the country's fauna and flora. His first documentaries for television were in 1966, the year when he made two expeditions to Africa, in which he filmed five programmes for the series *A toda plana* ("Full spread"). His most extensive series is *Planeta azul* ("Blue planet"), with 153 episodes (1970-1973). Afterwards, he wrote and produced the work that would bring him international renown: *El hombre y la Tierra* ("Man and the Earth", 1974-1980). In his documentaries, he used various narrative resources that helped bring science closer to the everyday reality of the viewers.

The work of these pioneers has allowed us to outline some of the key issues in understanding the coordinates along which scientific documentaries run and exclusively constitutes the launching pad for a subgenre that, over the years, has gradually become highly relevant for television. Its contributions have been of decisive help in shaping a prosperous global market, which we analyse in the following section.

An important international market

Although there are very few data on this area, we can state that, at present, the production and broadcasting of scientific documentaries has achieved a significant volume. The international production of documentaries, on any subject, is around a million hours a year and is fundamentally carried out in Europe (38%), North America (19%), Asia (17%) and Latin America (17%). Its market value at the start of the decade was calculated at around 400 million dollars (Real Screen 2001). Regarding the subjects covered, around 40% of this work is of scientific content, particularly "History and ethnology" (17.5%), "Discoveries, nature and wildlife" (13.7%) and "Science and knowledge" (12%) (MIPDOC 2001).

The breakdown of broadcasts by country is very unequal. The available data show us that, in Europe, those countries that broadcast most documentaries are Germany (around 11,800 hours/year), France (5,100), Spain (4,400), the United Kingdom (2,990), Italy (2,670) and Denmark (2,260). There are also significant differences between the number of channels that schedule these documentaries and the times they are broadcast in different countries (European Documentary Network, 2007).

Although there are no specific data on the broadcasting of documentaries of scientific content, in general public television channels schedule them most frequently, the most important being the BBC (United Kingdom), ZDF (Germany), ORF (Austria), France 2 and France 5 (France), ABC (Australia), TVNZ (New Zealand), NHK (Japan) and PBS (USA).

It seems clear that generalist channels have lost hegemony in this area, as around 70% of the documentaries are broadcast on specialist channels (Francés 2003). We might conclude that the rise in the number of channels has led to significant growth in production. However, in reality many channels restrict themselves to repeating programmes broadcast by others. Neither has it led to an increase in production costs, as many specialist channels rely on low cost programmes.

Worldwide, the most important specialist channels are Discovery Channel and the National Geographic Channel. Discovery, which started broadcasting in 1985, currently reaches over 450 million households in 160 countries. The channel's parent company (Discovery Communications) has 10 television channels and 85 different broadcasts in 35 languages. For its part, the National Geographic Channel, owned by the National Geographic Society and other firms such as the international group News Corporation, started broadcasting in 1997. It currently broadcasts via cable and satellite in 143 countries and 25 languages, and reaches 160 million households. The company also broadcasts five further different programmes.

In general, the countries where most scientific documentaries are broadcast are also those that produce the most. Although there are no data on world production, attendance figures at international forums of producers can provide us with some clues. In the most important professional congress for the speciality in 2007, held in New York, the countries with the largest number of producers registered were the United States (107), the United Kingdom (77), Canada (60), France (38), Australia (34), Germany (31) and Italy (23) (World Congress of Science and Factual Producers, 2007).

In Spain, the documentary genre, as a whole, is constantly increasing its presence on programming grids. The generalist channels that broadcast most documentaries are La 2 from TVE and the autonomous community channels K3/33, Punt Dos and ETB1. In terms of time, 64% of the documentaries broadcast were Spanish productions, compared with 22.5% European, 9.5% North American and 4% other nationalities (EGEDA 2006). There are no data on the broadcasting or production of documentaries with scientific content, although some subjects, such as nature, undoubtedly rank quite highly.

Among the trends observed in the international market, we can note the growing importance of commercial criteria. Research into audience ratings is decisive in selecting the subjects and design of the narrative modes. The stiff competition in the fight for audience share, in markets with a lot of channels, affects both private and public companies.

One of the consequences of this fight for audiences is the greater presence of types of documentaries where entertainment becomes the fundamental objective. According to John Corner (2002, 257), we are immersed in a "post-documentary" stage in which fun is the prime objective. Consequently, the documentary resorts to narrative elements from other genres and to a great extent loses its traditional sobriety and seriousness.

In the search for entertainment as a means of gaining audience, scientific documentaries have resorted to new strategies. One of the most successful is the use of hybrid genres. One of the most outstanding examples from the last decade is the so-called "dramatised documentary" which combines the narrative forms of the traditional documentary with dramatised scenes, played by actors, in which historical situations are recreated based on information provided by scientists. Leading examples of this format are *D-Day* (BBC - Discovery Channel – ProSieben - France 2 - Telfrance, 2004) on the Normandy landings in the Second World War, and *Pompeii, the Last Day* (BBC, 2003), which recreates life in the Roman city before the volcano Vesuvius erupted, which destroyed the town.

New technologies for a new documentary

As has happened with other television content, in recent years the expansion of digital technology has had a decisive effect on the development of the science documentary. The traditional 16 mm or super 16 mm film has given way to digital video formats, both of standard definition (e.g. Betacam digital) and high definition (HDTV). Cinematographic film has been relegated to large budget productions, particularly in the area of nature and animal life. Some directors continue to value the better quality of cinematographic images, with regard to sharpness and contrast, and the best results in slow motion, made by filming at fast speeds. However, the fact that the BBC recently chose high definition video to film its ambitious serious *Planet Earth* (2007) could mark the definitive end to celluloid for scientific documentaries.

The development of digital technology has reduced the cost and consequently increased the number of images created by computer, both in two dimensions and in three. In the case of scientific documentaries, this resource is of great importance, as it means that certain concepts can be represented in images that do not have an immediate visual representation. So it is possible to offer viewers a probable or plausible representation of theories developed in scientific fields such as physics or palaeontology. A leading example of this trend is the BBC series *Walking with Dinosaurs* (1999), where these animals are recreated, in this case using a sophisticated combination of image synthesising and animated real models over real images of the landscape.

After the great audience ratings achieved by this series, certain debate also arose on the accuracy of the recreations. According to some authors, this series is an example of the postmodern science documentary, where the contemporary aesthetic tends to eclipse the scientific content per se, giving way to pure spectacle based on science (Darley 2003, 209). On the other hand, other authors defend the validity of the recreation and even maintain that the images recreated might be, in themselves, a source of knowledge, insofar as the visual resources serve as an element to construct knowledge and not simply to illustrate it (Van Dijck 2006, 6).

The use of animated images has made it possible for television to tackle subjects that were previously considered to be inappropriate because of the difficulty in showing them in images. For example, the series *Europe, a Natural History* (BBC-ZDF-ORF, 2005) has achieved great audience ratings in various countries in spite of dealing with geology, a science traditionally forgotten by television. In this case, an innovative combination of real image and animation has made it possible to narrate the geological evolution of the continent in an absolutely captivating way.

Other techniques have also contributed to the proliferation of subjects. Some have been used for decades but have taken on a new dimension thanks to recent technological developments. In the very slow filming of processes, time lapse photography is often used. To carry this out, a timer is used called an "intervalometer", which automatically regulates the shooting of each image after a previously set period of time. Once filmed, the process can be shown in less time at a faster pace. This technique is used to record a wide range of processes, such as the flowering of a plant, the metamorphosis of a silkworm or the decomposition of an organism.

Sometimes, time lapse photography is combined with camera movements (travelling shots), coordinated by computerised systems. In this way scenes in movement can be filmed, recording dynamic but very slow processes (e.g. a plant growing up a tree trunk). A notable and innovative example of this technique is the series *The Private Life of*

Plants (BBC, 1995), where it was used to explain the life of nature from the original point of view of plants.

Viewing systems are required that allow us to see objects of microscopic size. When the object is too large to see through a microscope but too small for conventional photography, macrophotography equipment and techniques are used. In this case, macro lenses are employed, which magnify the object but preserve image quality.

In macrophotography, depth of field is very limited and lighting tends to be one of the main problems, as the light needs to be strong enough to show the details of small objects and the direction must be suitable to show these points. Artificial light tends to raise the temperature above what is ideal to reproduce certain processes, so that cooled equipment, cold light or fibre optic systems are required to concentrate a lot of light onto a small point, without releasing heat. In recent years, the equipment used to record this kind of images has developed considerably and has led to a notable improvement in the final quality.

In many cases, filming requires the development of special production procedures and techniques. In documentaries on nature and animal behaviour, filming is frequently carried out from hides to record scenes without altering the natural behaviour of the creatures. Other times, the images filmed in nature can be replaced or completed with others of animals in captivity or trained animals, which are taken to natural settings or studios where the natural environment is simulated. For some years now, remote control cameras have been used, as well as others that automatically film when any movement is detected. Thanks to these types of equipment, it has been possible to record surprising images of animal behaviour.

In the last decade, the use of interactive materials has gradually become more relevant, in some cases integrated within the broadcast itself and in others via the channel's website. In the case of scientific programmes, complementary information is usually offered on the subjects covered, including texts, complete versions of interviews, computer graphics, etc. In the case of interactivity offered via the television itself, interesting experiments have been carried out offering two or more alternatives in the narration, so that the viewer can choose the text's degree of difficulty.

The use of these strategies has helped to consolidate the position of the science documentary on television programming grids. In some European countries, such as the United Kingdom, Germany, Austria and Italy, great documentaries of scientific content are broadcast at prime time. This is possible thanks to the fact that public channels have been committed to scientific documentaries for several decades now, both solidly and continuously, which has led to high audience ratings in the medium term.

In other countries, such as Spain, the science documentary still needs to conquer prime time. This difficulty in accessing the times of maximum audiences must be attributed to the fact that Spanish public television channels, quite unlike some of their European cousins, have not shown any clear commitment to this kind of content.

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