European Commission

RTD info

RESEARCH AND COMMUNICATION

Special edition

ISSN 1023-9006

September 2002

Talking Science

Editorial

Gap or chasm?

Sciences + media = ? This issue is devoted entirely to the painful relationship between researchers and journalists. Painful? Unfortunately, the grievances are too many for comfort on either side of the equation. Scientists often take journalists to task for cursory if not inaccurate reporting, while journalists accuse scientists of being uncooperative and insular.

There can scarcely be a laboratory or editorial team anywhere that has not suffered some of the torments caused by this communication breakdown which is now common knowledge.

To explain this gap – which some would describe as a chasm – scientists often stress the fundamental incompatibility between the job of research and the practice of journalism. Whereas discipline and precision over a long period are the hallmarks of scientific research, speed, simplification and emotion are what the media are seeking.

Yet on closer inspection is the work of researchers and journalists really so different? Is not the job of the scientist to investigate the 'players' of this world and the 'stars' of the Universe to reveal their lives, their interactions and their secrets? And must not the journalist be objective, gather evidence and cross-check sources to reveal 'the whole truth'?

Surely scientists and journalists both seek exclusivity and work under the pressure of intellectual rigour? Are they not both 'reconstructing' reality by means of an account which obeys certain rules and conditions?

Everyone will make his or her own judgement. But we can – and should – see in this chasm one more indication of the distance which separates the 'two cultures' so dear to Charles Percy Snow. Even though, as usual, the reality is more subtle. Some scientists have become genuine media professionals, veritable stars of science, while some journalists possess a knowledge of science that is the envy of many researchers.

A magazine providing information on European research, RTD *info* is published in English, French and German by the Information and Communication Unit of the European Commission's Research DG.
Managing editor: Jürgen Rosenbaum
Editor in chief: Michel Claessens
Editorial Assistants: Stephane Hogan, Jutta Kastner
Tel: +32 2 295 9971
Fax: +32 2 295 8220
E-mail: research@cec.eu.int

Subscription is free on request
(please use the subscription form on page 20).

84 000 copies of this issue were published
All issues of RTD info can be consulted on-line at the Research DG's website
europa.eu.int/comm/research

At a time when science is having to respond to genuine challenges facing society – climate warming, food crises, breakthroughs in the life sciences – its media image has become a vital issue. How can we forget the clichés of 'superficial and irresponsible' journalists and 'able but insular' researchers and facilitate dialogue between science and the media?

Misguided or

On 9 July, at the invitation of the European Group on Life Sciences, about 40 high-level journalists and researchers sought to clear up mutual misunderstandings by trying to take a cool, hard look at the demands of their respective professions.

If the majority of journalists are to be believed, the press does not neglect science. Science is regularly in the headlines and most quality dailies have weekly science supplements or pages. 'In Germany, last year we published nearly 600 articles on stem cells and 300 on cloning, as well as devoting several pages to decoding the human genome,' explains Holger Wormer, a science journalist with the *Süddeutsche Zeitung*. 'As an indication of how aware readers have become of these issues, we can now see advertisers picking up on them and inventing the pleasure gene.'

Stirring up public feelings Meanwhile, the scientists speak of exaggeration and distortion. One such example concerns the views of the British doctor Andrew Wakefield who believes that the combined measles, mumps and rubella vaccine could be a cause of autism. His claims created quite a stir in the British press. As a result, a number of parents decided against having their children vaccinated. 'The media fuelled the doubts and uncertainties,' protests Bill Durodié, a researcher who is studying risk management at New College Oxford. 'There must, of course, be the opportunity to express *marginal* scientific opinions, but when such views cannot be based on repeated experiments they should be studied more closely by the peer group before being unleashed on the public.'

In Italy, a study of press articles and television news reports on biotechnologies published in 2001 also highlighted many shortcomings. 'The quality of information on genetically modified organisms remains insufficient,' believes Francesco Sala of Milan University. 'With a few exceptions, there is a lack of accuracy in articles sometimes confusing proteins and genes, GMOs and radioactivity, and with many omissions. Too often opinions are presented before giving the facts, thereby playing on public emotions. Imagine the effect of mentioning "radioactive pasta obtained from wheat subjected to ionising radiation."[1] This method went out of use 50 years ago,' Sala points out.

'The press does not act in the interests of science but in the interests of the public. The journalist first asks if the subject is going to interest his or her reader or listener.' **Above, the dramatisation of research for BBC viewers (Life Story).**
© BBC

Goals and deadlines What do the journalists say? According to Geoff Watts of the BBC, 'these are two professions which do not necessarily share the same goal. The press does not act in the interests of science but in the public interest. The journalist first asks if his subject is going to grab the attention of his reader or listener and not if it is essential to enlighten society.'

The very essence of these two approaches is also quite different. 'Journalists are under constant pressure, bombarded with new information all the time,' points out Cristina Ferri, correspondent for *Le Scienze*, the Italian version of *Scientific American*. 'Each news item raises questions which must be answered that same day to meet the deadline for the next edition.' This is a long way from the world of research where finding the answers can take years and nothing is published until the process of peer review brings the stamp of approval from fellow scientists.

misunderstood?

The Swedish doctor Ragnar Levi[2] suggested that a similar system should be applied to the press, but it is hard to see how it could work in practice given the time pressures under which journalists work – and their fierce commitment to 'freedom of the press.'

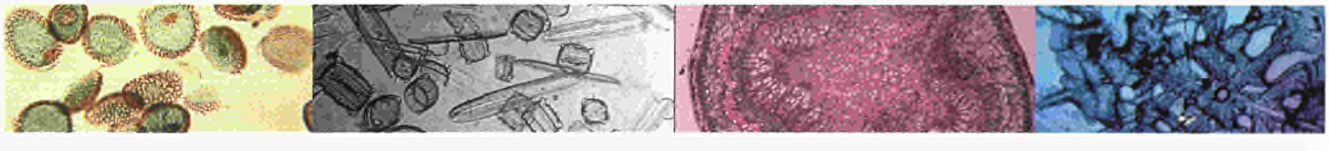
Jumping on the bandwagon Nevertheless, Kornelia Smalla, a researcher at the Federal Centre of Biological Research for Agriculture (BBA) in Berlin, feels she has often been betrayed: 'We have tried to get our results reported but they have been interpreted very badly. Sometimes, even if the article itself is quite accurate, the headlines are misleading.'

'When we are interviewed about a discovery, we would like to be able to read the articles before publication,' adds Pascale Cossart who is studying interactions between bacteria and cells at the Institut Pasteur. 'But journalists can be very sensitive about that.' Alicia Rivera, a journalist with the Spanish daily *El Pais*, has no problem when 'scientists correct a factual error in an article', but will not tolerate any interference when it comes to presentation: 'let the journalists do their job.' This is essentially the almost unanimous response of British journalists to the proposal to draw up guidelines, following a House of Lords' report on science in the media.

Apart from the sometimes superficial or sensationalist nature of press reporting, another frequent criticism is the habit of jumping on the bandwagon. 'Once several media have reported on a given subject, the others then usually follow,' admits Catherine Vincent, a journalist with the French daily *Le Monde*. 'These subjects are often suggested first as a result of the very effective communication strategy of major science journals such as *Nature* and *Science* which highlight the most fascinating subjects in their tables of contents.' Hence the impression that the science pages in the leading dailies all have very similar content – which benefits Anglo-Saxon research at the expense of work being carried out in other countries which may be just as interesting.

Another consequence of this is that researchers may have the impression that they are being contacted to back up information obtained from elsewhere rather than to explain progress in their own work. 'Around 80% of the information requests we receive are of this kind – only 10-15% are about new discoveries

(1) Reported by the Frankfurter Allgemeine Zeitung, *this was seen as an attack against the Italian agri-foodstuffs industry.*
(2) Ragnar Levi, Medical journalism: exposing fact, fiction and fraud, *Studentlitteratur, Lund (Sweden), 2000 www.studentlitteratur.se*



Science Generation

Commissioner Busquin has announced the Commission's support for extending the *Science Generation* project to Italy and Sweden. Launched two years ago by the Aventis Foundation and the Institut de France (www.science-generation.com), it aims to create – in the field of biosciences – networks of scientists, students and journalists, organise symposiums and opinion surveys, and hold debates both on-line and in the field. Last March, 500 young people, parents and teachers met at the French Senate to vote in favour of setting up working groups to look at topics such as science which is closer to everyday life, schools more open to science and more accessible scientific information. The experience will now be repeated in Italy under the aegis of the Italian Federation of Science and Technology Associations – FAST (www.fast.mi.it) – and in Sweden through the Royal Swedish Academy of Science and Technology – IVA (www.iva.se). It may spread to other countries through a partnership with the Euro-CASE (European Council of Applied Sciences and Engineering – (www.euro-case.org) network of 18 academies.

we have made,' estimates Olivier Hostens, director of external relations at the Facultés Notre-Dame de la Paix in Namur (Belgium). When pressed a little further, he also expressed some criticism of the attitude of university scientific circles which, he believes, often 'resist communication, especially as they do not depend on the press for funding.'

Are researchers introverted? According to Professor Derek Burke of the Institute for Food Research in Norwich (UK), 'there is a danger of creating a false image of science. The current critical period in relations between science and society is the result of the same public mistrust of any authority, whether politicians, the media or research.'

So is it time the scientists took the initiative? Fiona Fox, director of the Science Media Centre (3) in the UK – charged with making the research community's voice heard in the media when 'science hits the headlines' – tends to think so: 'Scientists must make themselves available to the media to the same extent as certain pressure groups or NGOs.' The latter are very quick off the mark to make documents and contacts available to journalists on the majority of 'sensitive' issues.

This view is shared by the journalist Bernard Dixon, a microbiologist by training, who believes that 'scientists and their organisations should be encouraged and helped to be more proactive in their relations with media and society. They should anticipate causes of public concern and not simply dismiss them as irrational. Also, scientists make too little use of the opportunity to express their views in newspaper articles or opinion columns.'

The study day also produced a number of suggestions for possible ways forward: media training workshops for scientists; meetings between researchers, the press and the public; the election of European Union *science ambassadors* to promote contacts between researchers and journalists; encouraging universities and research agencies to use PR agencies to circulate their information; and the launch of a prize for science journalism. These ideas will serve as a basis for proposals to be submitted to the opinion of communication professionals next October at the 2002 World Congress of Science Producers in Berlin.

But will they be enough to renew dialogue between science and society? No doubt not, or not unless they get to grips with the problem in the long term, stresses Professor David McConnell. A geneticist at Trinity College, Dublin, he believes that: 'We must strike at the root of the problem, and that means education. Without a minimum of general scientific knowledge, without some grasp of how science functions, younger generations will not understand the research message at all. And it is these young people who are tomorrow's politicians, decision-makers and communicators.' In the meantime, dialogue between journalists and scientists must be based on mutual knowledge and respect. ●

(3) The Science Media Centre was set up following the House of Lords' Science and Technology Third Report, *published in 2000, with the support of a number of science companies and organisations. Its aim is to promote balanced, accurate and rational scientific coverage of the controversial science stories that hit the headlines.* www.ScienceMediaCentre.org

'Scientists must make themselves available to the media just as much as certain pressure groups or NGOs.'
Above, Greenpeace action against Russian whalers in the North Pacific.
©Greenpeace/Weyler

New Biopress prize

In November, during European Science and Technology Week, the European Molecular Biology Organisation (EMBO) will be awarding a prize of €5 000 to a European researcher who, through his involvement in communication activities, has contributed to a better understanding of life sciences by the public.
www.embo.org

To find out more about biotechnologies and the press

- European Federation of Biotechnology
  www.kluyver.stm.tudelft.nl/efb/
- Task Group of Public Perception of Biotechnology
  www.efbpublic.org/
- Coverage of biotechnologies in the Italian press: report by the Pavia observatory:
  www.osservatorio.it
- Dossier on communication questions in Spain
  www.biomeds.net/biomedia/dossier_comunicacion.htm

'Exponential' scientific progress, an omnipresent media environment, obvious political and economic interests – in such a complex world, more and more researchers are being expected to 'communicate' their work. Meanwhile, the media, no longer solely concerned with 'popularising' science, cannot ignore relations between science and society.

Form and content

It is all becoming more complicated,[1] believes Dominique Wolton, research director at the CNRS (France). The direct interface between science and the public has been replaced by a four-way relationship: science, politics, communication and 'publics.' Moreover, it is not just the concept of the public which must now be considered in the plural: an increasingly complex and multidirectional science has become *the sciences* and, like technology, they are now inextricably linked to political decisions and economic competition. 'In the past the word was popularisation; now it is mediation, promotion through the media, and enhancing the value of research. This multiple terminology is indicative of the difficulty in building relations between the sciences and society,' he writes. Also, in a context in which science is increasingly discussed and where communication is increasingly omnipresent, Wolton identifies a double risk: 'flight into a *scientific ghetto* in defiance of the pervading media promotion' or embracing a 'logic which is too communicational and which denies the specificity of scientific activities.'

Meanwhile, some claim that researchers are concerned with content while the media are busy with form. It is scarcely surprising, therefore, to find misunderstandings creating conflict between the two professions, which is far from new (see *Misguided or misunderstood?*). Yet at the end of the day they need one another. Many scientists are not content with the specialist journals (*Nature, The Lancet*, etc.) where their results must meet with peer approval before they can be published, or even with articles in science journals aimed at an informed readership. Researchers seem to be feeling a growing need for recognition which, apart from any narcissism, strengthens their personal standing among their hierarchy or fund providers. This standing is now partially determined by the mass media.

Greenpeace: the marketing drift

As part of its policy of developing its 'press' service into a fully-fledged marketing strategy, Greenpeace advises the company Ikea, sells derived products and regularly makes the news with its sometimes quite spectacular marine interventions. 'You must not confuse the public, media and market arenas,' points out Eric Dacheux, a lecturer at the Technological University of Roanne (France). He condemns a shift in the language with talk of targets, markets and products, a certain loss of identity – i.e. that of a non-profit ecology association – and a certain attitude to the public. This researcher believes that 'marketing communication can seduce a consumer, but finds it increasingly difficult to hold the attention of a zapper audience and hardly ever induces people to commit themselves to active campaigning for a cause.'

Everything has a price...

17 March 2002: The *Sunday New York Times* devoted a full page to the work of Pierre-Marie Robitaille, professor of radiology and molecular and cellular biochemistry at Ohio State University, on the liquid nature of the sun – an idea that directly contradicts accepted thinking. Perhaps strangest of all, however, was that the page was in fact an editorial-style advertisement which cost its author about 100 000 dollars to place. 'I have never submitted this paper to a scientific journal and I was advised by a senior scientist to opt for this course of action. It was something I had been thinking about for almost four years,' explains the author.

Of course such an avenue is only open to those who can afford it. So what about the others? Apart from subjecting oneself to the constraints of peer review, there is still the Internet. But Pierre-Marie Robitaille does not believe the two are comparable. 'Papers published on the web just get lost and many authors see this as a purely academic exercise. Nobody ever sees most of these texts. To be read, you have to be known. I am pleased to think that more than 20 000 people will no doubt have read the *New York Times* article and given it serious thought. I do not think it would have been possible to reach as many people through the Internet.'

Do you want to know more?
www.thermalphysics.org

A mutual learning process How then can the foundations be laid for mutual understanding between these two worlds? A few years ago, the European Federation for Biotechnology devoted one of its newsletters to *Relations with the media*. A Task Group on the Public Perception of Biotechnology (chaired by John Durant, a specialist in scientific communication and curator of the National Museum of Science and Industry in London) was also set up to 'explain to scientists how the media operate.' This already stressed – in 1996, but nothing has changed since – that when seeking to arouse media interest in a subject it is useful to know what topics are in vogue, although it is still possible to present a new slant on subjects even if they are already in vogue. Researchers were also warned that any journalist is likely to be something of a snooper, prone to ask questions on the funding of the research, the consequences of biotechnologies for consumers, or the impact on exports or imports. A researcher forewarned is a researcher forearmed, would seem to be the message. The researcher was advised to be always on his or her guard, the interviewer – sometimes seen as some kind of paparazzi – expecting rapid answers lasting 30 seconds at the most.

To help researchers, the British and Canadians have even published a very basic pocket guide.[2] But basics can sometimes, of course, be very useful...

As to the journalists, there are many specific courses of varying duration open to them, as well as special diplomas throughout Europe (and the United States). A number of universities (Barcelona, Paris, Dublin, Cardiff, Trieste), professional associations (in particular the European Union of Science Journalists Associations), and scientific institutions, such as the Max Planck in Germany or The Royal Society in the United Kingdom, provide training, publish manuals, and invite the press to meet scientists. But their clients are not only recruited from the press in the strictest sense of the word. 'Some of these courses are also aimed, sometimes primarily, at the communicators or mediators of sciences,' points out Patrice Lanoy, a French journalist who headed the sciences team at *Le Figaro* for many years. 'These are altogether different professions. A journalist seeks information (original if possible), fights his corner to ensure it has the place he thinks it warrants, protects his sources and can summarise. A mediator commands the communication techniques which enable him to translate a scientific breakthrough (if linked to a public or private laboratory) or a wider scientific or technical problem (such as in connection with an exhibition or other event) into understandable terminology.'

New mediators These specialised spokespersons are certainly not short of work. 'In the current climate of communication overdrive, it is becoming easier all the time to gain access to the press releases of prestigious scientific journals, and to fuel our imaginations with the continuous flow of information from the powerful communication agencies. The real problem is the inability to exercise any discernment as a result of the communication time we are allowed,' explains Vladimir de Semir, journalist with *La Vangardia* and head of the Scientific Communication Observatory in Barcelona.[3]

A lack of time? Members of the press also know that they can obtain – at lightening speed – information, photos, addresses, documents or a meeting through such 'interfaces', without which their work would be very laborious. A growing number of scientific communicators also have scientific training and know what they are talking about. Some are even passionate about their subject matter and want to communicate their enthusiasm to others. This is true of Claus Madsen and Richard West of the European Southern Observatory (ESO) who are able to immerse their interlocutors in the wonders of astronomy, providing not only information but also pertinent reflection. They see communication as a central element of science, the same as a material element in an observatory or laboratory. Just as a sophisticated optical instrument makes it possible to discover a detail in the immensity of space, so succinct communication can shed light on an image in the public mind.

They like to explain that astronomy is a hyper-complex mechanism, encompassing an impressive number of research disciplines (mathematics, physics, geology, biology, etc.) and conveying many fundamental scientific concepts such as distance, time, relativity, elemental particles and natural forces such as gravity or electromagnetism. While being aware of the impressive beauty of images of the universe, ESO website[4] also gives scientific and technical data as an invitation to further investigation. ●

To find out more on the Web

Science and media relations – practical guides

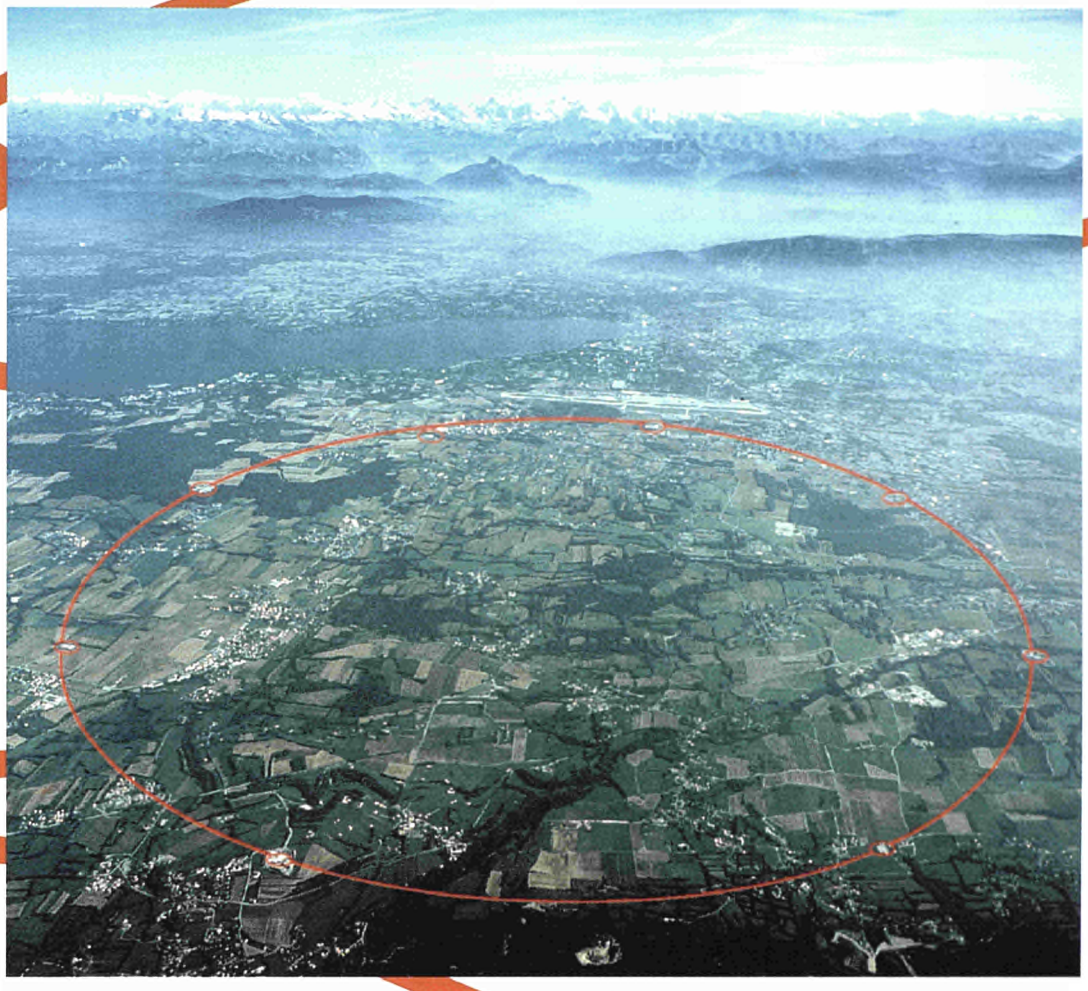
- European Union of Science Journalists Associations
  www.esf.org/eusja/EUSJA.htm
- The Royal Society
  www.royalsoc.ac.uk/international/index.html
- Institute of Scientific & Technical Communicators
  www.istc.org.uk
- IOP Electronic journals, published by the Institute of Physics
  www.iop.org

Europe, science and society

Through its action plan on Science and Society, the Commission aims to encourage projects to increase public awareness of science, in particular through the creation of a scientific press agency, the awarding of a special prize for scientific communication, the translation of scientific communication products and the development of multimedia products (television programmes and publications) aimed at a mass audience.
http://www.cordis.lu/rtd2002/science-society/home.html

1 When researchers become journalists. Above, Ranga Yogeshwar, a physicist who worked at CERN for a number of years, is a past master in the art of making science accessible – and attractive – through his programme *Quarks & Co* (WDR – Germany).
© WDR/Schulze

2 Researchers and journalists together in the field... A Dutch TV report from a site rich in fossils on the bed of the former River Eridanos. Here, using a seismic map, the scientist Salomon Kroonenberg presents the historical data for the programme Noordelicht (on VPRO).



Communicating science? The mediators – some of the most skilled among them employed by major scientific institutes – build bridges between research and the press. By accessing the CERN site, for example, any journalist can download pictures and documents for his or her reports, and contact key figures.
© CERN

(1) In the introduction to Sciences et medias, *n° 21 of* Hermès *magazine, CNRS Editions.*
(2) Basic guide for scientists with communication questions, *available in French and English:*
www.dti.gov.uk/ost/ostbusiness/puset/g_public.htm
> www.nserc.ca/seng/how1fr.htm
(3) www.tribunes.com/tribune/alliage/37-38/semir.htm
(4) www.eso.org/
Claus Madsen and Richard West participated in the 6th International Conference on Public Communication of Science and Technology from February 1-3, 2001. The full text of their paper can be consulted on the Internet:
http://visitsservice.web.cern.ch/VisitsService/pcst2001/proceedings_list.html

Gero von Boehm –
'The important thing is to win the confidence of scientists.'

A committed freelancer, working for Arte, ZDF, 3sat and *Der Spiegel*, Gero von Boehm has two passions: art and science. He spends most of his time travelling the continents of the world to meet the men and women who live for creation and research.

Portrait of a portrait artist

Half-tones, beiges and greys, the occasional touch of light blue ... minerals, sometimes lead, applied to the surface of the work ... patterns, areas of light and shade, nebula, vast empty spaces with fleeting forms – Gero von Boehm turns the pages of an album of recent works by Anselm Kiefer, and talks about this painter who symbolically evokes Germany's cruel past and about whom he is making a film. 'Our brain contains the same matter as the stars... Kiefer expresses this. All his images have a significance, convey symbols, and refer to the myths of different places and cultures.'

The meeting of two worlds Von Boehm has produced profiles of artists including Giacometti, Matisse, Balthus, Henri Moore and David Hockney, as well as on such figures as Stephen Hawking, Steven Weinberg, Luc Montagnier, Harald Zurhausen, French Anderson, Edward Wilson and François Jacob. 'There are very strong links between art and science. Music and mathematics have often been compared for example – even the smallest equation has its own harmony. It is important for me to encounter these two worlds and to work in both areas. When I produce a portrait of an artist, it is always very stimulating visually and it seems to me that subsequently I am better able to translate science into pictures and to find a common aesthetic theme with which to guide my audience, as it were.'

On each occasion, it is a question of revealing a person and a personality. 'If the subject is a scientist, it is a way of showing that research is carried out by men and women who have themselves been beset by many doubts and anxieties. Paradoxically, this is a way of reducing the fear that one may have of science.'

Gero von Boehm finds potential subjects for interviews through his reading (*Science, Nature, Journal of Medicine*, etc.). 'I discover people and their work. I try to understand why they are interested in particles or the stars or whatever. I telephone them, write to them, and we meet before we start filming. Sometimes of course we do not make a film, but I am rarely disappointed.' He understands perfectly the doubts scientists may have regarding the media and the prospect of popularising science. 'If I have the slightest doubt I call them. If they think I have simplified some elements too much, we negotiate – sometimes over a sentence or just a word – but we always find the right balance in the end. It simply takes a bit of work. The important thing is to win scientists' trust.'

Ethics and genetics Despite this desire to discuss and develop a relationship of trust, von Boehm maintains the critical eye of the journalist: 'Our duty is to show scientists – who do not always have the time to think about this – the fears and anxieties of society and in particular to ask questions about ethical aspects of research.' Genetics, for example, is a field in which very convincing scientists are 'determined to pursue their research and they are under great pressure from patients – and their families: 'The parents of sick children are a strong force in society and who can deny them hope? But you start with illnesses and then end up with something else. Can you give me one example in the history of science of a development which was not allowed to reach its ultimate conclusion? Science usually presents us with a *fait accompli*. Today the media and pressure groups are delaying this culmination, for now.'

Gero von Boehm's next project is entitled *DNA, the time machine*. Through interviews with European and US scientists, this document will try to show how genetics enables us to travel back to the past ('What were Eve's genes? We don't know, but we can analyse dinosaurs') and to influence the future ('Perhaps by trying to improve ourselves, in any event physically, as has happened in the evolutionary process.')

New Mexico – Shooting *Odyssee 3000*, a document on new viruses.

The independence bug A genuine workaholic with an undying passion for discovery and an unfailing ability to be amazed, this international traveller ('after two weeks at home, I have to set off...) has worked in all media. He started in radio in 1975, then wrote for *Die Zeit* before moving quickly into audio-visual. In 1978 he founded the company Interscience Films with his wife Christiane, an expert at finance, production and management. He has always been a freelancer and jealously guards the real freedom this status brings ('we always wanted to be independent film-makers, if only to be able to choose who we work with. For the past 20 years we have worked mainly with the same cameramen, editors and technicians.'). Gero von Boehm is now Art and Science correspondent for the German public channel ZDF, as well as producing and supervising the German section of the weekly *Archimède* and ZDF programmes included in the cultural magazine programme *Metropolis* for Arte. He has also just started a series of interviews to be broadcast on the cultural channel 3Sat, and writes regularly for *Der Spiegel*.

Television is therefore his principal outlet. However, 'I love the big screen and you clearly have greater freedom with a cinema film than on television. But it is very difficult to get the financial backing to make a film and I am too impatient. I like to start shooting without hanging around for too long.' The fine line between a document and documentary is sometimes blurred, however. Kiefer will be shown in cinemas, for example, while the Frankfurt Museum of Modern Art has just exhibited a Gero von Boehm retrospective.

In his film-making he always remembers his training as a lawyer: 'I studied law to acquire structured thinking and it is an approach I have retained. But I never wanted to be a lawyer. I would have liked to have been a writer.' This modest man does, in fact, write regular profiles for *Der Spiegel* and is the author of a book on the architect Ieoh Ming Pei, designer of the Louvre pyramid, 'because I like to say things that cannot be expressed in pictures.'

Words and pictures This master of the audio-visual believes that 'you can be much more subtle with words. Pictures are limiting in the sense that you are always obliged to show something, but it is often only the surface. Pictures can reveal, but they can also conceal.' This is perhaps why the interviews he does for 3Sat are face-to-face against a black background, intimate and close-up, almost like a conversation in a café. The interviewees bring along a few mementoes, objects or photos, and speak about their lives and work. Each interview lasts 45 minutes and goes out at 10.20 in the evening. 'That's good,' he says modestly, 'because interviews of this kind are usually broadcast after midnight.' The next subject will be Carl Djerassi, co-inventor of the contraceptive pill and owner of the world's largest collection of the works of Paul Klee. He is a fascinating man, elderly now, and the author of novels and plays. He has written about his life in *The Pill, Pygmy Chimps*, and *Degas' Horse*, the latter being almost science fiction.

'Pictures,' continues von Boehm, 'show a reality, rarely the truth, although truth is a very big word which I do not really like to use. If you are really lucky you can show the reality of science today. To show the reality of a man or woman, of a scientist or an artist, is already a great deal. As to the truth, I have no pretensions about that. One can reflect upon it... You must be modest.'

Modest is a word which crops up frequently in the conversation. Modesty is also apparent when talk turns to making other kinds of films – for example, fiction films. 'All film-makers are tempted by fiction, but when you consider just what a huge undertaking they are... I think you have to start very early.' Yet he aspires to another life, or rather a parallel life in which it would be possible to write screenplays, far from the city: 'You sometimes want to work alone, not to speak or have the telephone ringing, but simply to be and to write. A dream perhaps...' ●

The strength of sound

Can the absence of pictures actually be a strength? Radio journalists certainly think so. Scoop and sensation are not their priorities and time is a luxury they can still afford. 'I don't try and be too clever, but I do try to be distinctive,' explains Jacques Olivier, a journalist with Belgian French-speaking radio.

'I can't write an equation on the blackboard, but I can allow words to speak.' This is how Jacques Oliver, a journalist with the RTBF – the Belgian French-speaking public channel – sums up his radio work. The producer of a weekly science programme is convinced that radio offers scope for a daily programme of this kind. 'But science is initially rather off-putting. The station bosses often find it complex, boring, and incomprehensible – and so do the public. That is why it must be presented in clear terms, without hurrying to place it in context. It must be presented, in a sense, by taking things one step at a time.'(1)

Freed from the screen Radio's obvious limitation can be its main asset: by not having pictures you are freed from their control. It is not possible for radio to grab the attention with the dramatic or spectacular ('radio does not aim to turn the world on its head whereas television is forced to dramatise the world'), but what could seem to be a shortcoming is in fact the guarantee of freedom. It is also impossible for radio to focus on entertainment to the extent that television can. 'I am sometimes perplexed by the playful presentation of science. If you really want to improve public understanding of science, I doubt that it is possible to remain at the entertainment stage without ultimately trivialising it.'

Working alone or in small teams, radio or press journalists have their own advantages over television, such as in the quality of the relationship between the interviewer and interviewee. 'Relations can become deeper and more intimate. There is time to discuss, prepare the programme together, and the microphone is also less obtrusive than a camera and spotlights.'

This does not mean it is easy to work with the researchers' words alone. Cutting and editing are essential. 'Scientists are generally used to speaking, but they tend to deliver a formal lesson. It sometimes takes a lot of work to achieve a certain fluency.'

Chance and the vacuum Every week for two years, from 1998-2000, Jacques Olivier fronted *Semences de curieux*, presenting about 100 programmes in all. This magazine programme came about almost by chance. 'A radio slot became free and we realised that we didn't have any science programmes at all. It was this vacuum which brought the response and not the desire to have a science slot in the schedules.' Significant perhaps?

Speaking of vacuums... Jacques Olivier remembers a series on Planck's Constant and the vacuum. Although not at first sight particularly media-friendly subjects, they nevertheless won an audience. 'There is no miracle recipe, that is the basic rule of journalism. To make a subject interesting and ensure it gets an audience, you have to prepare it thoroughly, obtain documents, read a great deal, know what you aim to do and ask the right questions. That said, on more than one occasion I have listened to scientists without understanding a word they were saying when I thought I had a good grasp of the subject. But that is all part of the game.'

Since *Semences de curieux* Jacques Olivier has presented the weekly history programme *Memo* and now dreams of making a new, more specific programme on the history of science. 'Everybody knows Pythagoras' theorem, but Pythagoras also represents a very special view of the world which is not necessarily known. History enables us to put science into perspective, to see where we have come from, where we are and – why not? – where we are going.'

Jacques Olivier: 'Everybody knows Pythagoras' theorem, but Pythagoras also represents a very particular view of the world which is not necessarily known.'

(1) All quotes are by Jacques Olivier.

Children first

During the week the recorder registers dozens of questions. On Sundays the researchers reply. The questions are asked by children, some of them as young as three or four, often alone and sometimes in class. Very sensible questions, seemingly simple but involving complex concepts. Why are clouds grey or white? How does the wind obtain its strength? Why do I want to be like others? What are eyes made of? How old is the moon? Did people brush their teeth at the time of Louis XIV?

Most of the children who ask the questions are aged between six and 14. Their questions have to be listened to, sorted, grouped and then half a dozen selected. 'When their question is not asked, some call back and complain,' says Noëlle Breham, producer of the programme *Les p'tits bateaux* on France Inter. (1)

At 7.30pm on Sunday evenings, scientists and specialists give their answers in simple terms. A paediatrician may describe how milk is produced in the mother's breast, a vet might explain why cats always land on their feet, or a mathematician says why minutes are divided into 60 seconds and not 100.

'As we want the answers to be precise, the guests must be recognised specialists. We simply ask them not to exceed four minutes and not to use complicated words, without being simplistic,' explains Noëlle Breham. 'But as they know they are addressing very young people, they naturally refrain from using jargon.'

Who are their listeners? Children, of course. But parents too. This kind of programme teaches adults a great deal, enabling them to understand things they would have never dared ask about.

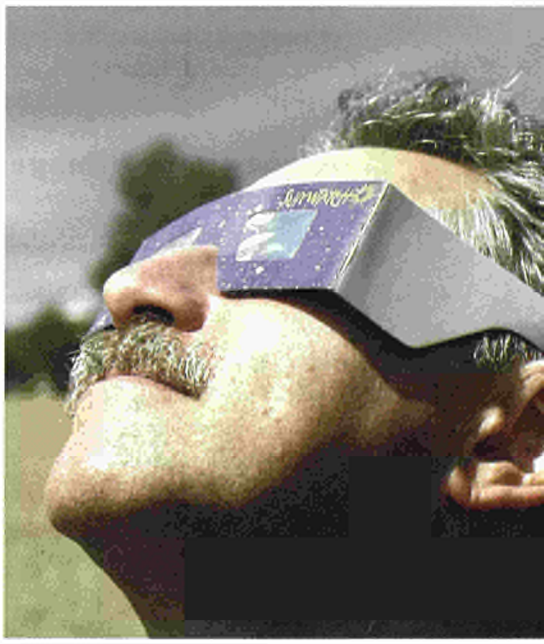
(1) Named after a French nursery rhyme:
"Maman, les p'tits bateaux, qui vont sur l'eau, ont-ils des jambes?
Mais non, petit bêta, s'ils en avaient, ils marcheraient."

© Louise

The summer of science

Tout s'explique... Every morning at 11am throughout the summer, Denis Cheissoux asks questions about the seabed, termites, the sun, Leonardo de Vinci and thunder. The programme comprises 30 minutes of dialogue and two or three songs for a little light relief. The key task is to find the right interviewee. 'Our job is to find the right person for radio – whether it is a Nobel prizewinner or somebody much less well known. There are some people who know everything and say nothing which, of course, is no good.' For a programme aimed at the general public and seeking to be 'light and instructive', the most important requirement of a radio scientist is that he should be easily understood. 'Do not try and say everything, that is the rule. Popularisation can be frustrating, radio too.' Denis Cheissoux (with France Inter for the past 30 years and presenter of the famous *L'as-tu lu mon p'tit loup* devoted to children's books) is passionately interested in the environment (as illustrated by his long-running *Chassez le naturel*) and chooses his subjects according to his mood, completely subjectively. 'An idea can come to me when I am riding my bicycle. I then want people to explain it all to me, to make up for what I didn't learn at school.' Next comes the audio casting. 'We select by telephone. The telephone is like the radio, and we know immediately if the voice is going to work or not – we don't need to meet the person first.'

This morning it is Sylvie Vauclair. An astrophysicist at the Midi-Pyrénées Observatory and professor at the Paul Sabatier University in Toulouse, she is talking about the sun. How big is it? How did it originate? When will it die? What is an eclipse? 'The reason we can exist is because there were stars before the sun.' Sylvie Vauclair also talks of solar storms and the sounds this burning star emits ('it acts like a huge musical instrument, it is a resonance chamber, the role of the bow is played by the movements, the explosions, everything which rotates around the sun...'). Denis Cheissoux makes no apology for hopping from subject to subject. One moment it's the Milky Way and the next the moon, before suddenly coming back down to earth and the subject of solar power. The pace is fast and it really does make you want to know more.



Phenomena such as the solar eclipse of 11 August 1999 received widespread media coverage and attracted a wide audience. Some journalists see quality popularisation as the way forward.
© ESO

www.radiofrance.fr/home-inter.htm

Some 66.4% of Europeans 'prefer to watch television programmes about science and technology than to read articles on the subject.'(1) As the media 'king', how does television communicate scientific knowledge? Is the emphasis on informing or entertaining? Who are science programmes aimed at? Is a European science channel a feasible proposition? TV science comes under the spotlight as we try to find some answers.

The secret of small

'Television news traditionally treats science as a bit of a break from the heavy stuff, going for optimism and spectacular pictures, such as those taken by the Hubble telescope. It offers an element of surprise, the cherry on the cake,' believes TV and newspaper journalist Patrice Lanoy, a physicist by training and current president of the Association des journalistes scientifiques de la presse d'information (France). 'More serious questions are covered in greater depth at other times, in particular by science programmes broadcast by certain European channels – some of those for young people being very good indeed – and the documentaries which are the main diet of the theme channels.'

A question of image(s) With a few exceptions, science programmes are scarcely considered as likely to boost audience ratings. Most channels therefore give priority to subjects with a certain popular appeal, such as health, the environment, biotechnologies and space. These are aimed at a wide audience, with the emphasis being on the popularisation of science and a dramatisation of research to appeal to the viewer's imagination. Scientific disciplines are therefore dependent upon their image – and their images, in terms of their ability to provide sequences which should preferably be spectacular, poignant or shot in far-away or exotic locations. The animal kingdom lends itself very readily to this, many wildlife programmes being assured a comfortable success.(2) Ethnographic documentaries appeal simultaneously to our curiosity and love of the exotic, while archaeological documentaries have an element of mystery and can be portrayed in a manner worthy of the very best detective stories. As to astronomy and space research, these are clearly subjects that can grab the viewer's imagination. On the other hand, subjects such as maths and physics are clearly going to find it more difficult to make their way on to the TV screens, unless the focus is on very concrete applications.

Matière Grise

(RTBF – Belgium)

First broadcast in 1998, *Matière Grise* goes out every five weeks on RTBF. It has become a reference in the Belgian audio-visual landscape, praised for its solid content, simple structure and dynamic presentation. Its producer and presenter Patrice Goldberg is determined that the language should be accessible to all. As a result, it regularly attracts a large audience, despite its 10.30pm slot on Thursday evenings.

www3.rtbf.be

E =M6 (M6 – France)

Over the past ten years, the *E=M6* team has managed to attract a weekly audience of 4 million viewers to this popular weekly science programme which goes out at peak viewing time on this private channel. The magazine programme aims to increase understanding of nature, the world and technologies around us. Science is often explained through the prism of daily life, with experts from various disciplines (doctors, sociologists, nutritionists) analysing the day-to-day life of a French family, for example. Special programmes also try to shed light on an increasingly complex environment, thanks to the answers provided by scientists and technicians.

www.em6.fr/

screen success

Animals and action... A tried and tested formula used successfully in the series *Walking with Beasts* produced by the BBC. © BBC

Equinox

(Channel 4 – United Kingdom)

This is the principal science slot of the British public service channel which devotes 5% (£20 million) of its annual budget to programmes on science and education. These cover topics such as health (*Body Story*), space (*Destination Mars, Planet Storm*), robotics and archaeology (*Lost Worlds*). As Science and Education co-ordinator Sara Ramsden explains, Channel 4 is interested in 'any good programme, with a serious content and entertaining presentation, which is able to render science comprehensible, pertinent and fascinating for the general public.'

www.channel4.com/science/index.html

Archimède

(Arte – France/Germany)

In what way does science affect us all? The weekly magazine programme *Archimède* tries to provide some clear answers to this vast question. Each programme covers five or six subjects, approached in a variety of ways, in an attempt to make viewers more aware of scientific research. It is produced by Ex Nihilo for Arte France and ZDF. For enthusiasts, Arte has also just launched a series devoted specifically to the world of trees (*Sylva*) and a series of documentaries on archaeology (*L'aventure humaine*).

www.arte-tv.com/emission/emission.jsp?node=-65

Varied landscape 'Science continues to suffer from a dull and bookish image, which is an obvious turn-off for TV bosses whose main fear is losing audience share,' believes Kathleen Van Damme, senior consultant in audio-visual communication with DDB Focus Europe, which recently carried out a feasibility study at the request of the European Commission (see box *A channel portal* on page 20) for a possible pan-European science channel. Yet a number of channels have managed to attract a significant audience by producing science programmes of real quality. The secret? 'You need a different approach to science in pictures. If you can provide quality and originality, you will have an audience... and commercial success too,' continues Kathleen Van Damme.

She believes the problem is 'not so much a matter of the quality of science programmes, which has been improving for some years now, as the actual quantity broadcast, which varies greatly from one country to another.'(3) There is considerable scope in France, where there are two educational and cultural channels, and also in Germany and the United Kingdom, with over 20 hours of science and technology programmes weekly. Countries such as Portugal and Spain, on the other hand, have very few specific programmes, with the exception of l'*Aventura del Saber*(4) on TVE.

(1) Europeans, science and technology, *Eurobarometer 55.2, European Commission.* RTD info *devoted a special issue to this survey in March 2002.*
(2) 5.7 million people went to the cinema to see Microcosmos, *a film by Claude Nuridsany and Marie Pérennou on the life of insects, and 1.5 million have already seen Jacques Perrin's latest film,* Winged Migrants, *about birds.*
(3) The number of channels that can be received by direct satellite reception is in practice limited to 150 and operators give priority to their own channels. More channels does not therefore necessarily mean that more channels are arriving correctly at their destination.
(4) At the time of going to press we do not know if this programme will continue.

Although this Portuguese production is very popular, it is aimed at children and there is no follow-up programme to make the early teens more aware of questions of science. 'It is not easy to determine *which young people* you are seeking to address,' points out Piero Angela, producer of the programme *SuperQuark*, which has been remarkably successful on prime-time TV on Italy's RAI station. 'The adult public is much more homogenous and, by using a simple level of language, you can reach a mass TV audience. Among young people, the ability to understand changes very quickly from one age group to another – you do not speak in the same way to a child of six, eight, ten, 12 or 14. But it is difficult to convince people that such a limited number of young TV viewers warrants such major investments. That said, it is certainly worth trying.'

Anja Philip, the intrepid presenter of *Viden Om (Know all about)* on board a Danish Air Force Navy Lynx helicopter. © Bjarne B. Hermansen

The cost of super co-productions With the development of ideas, document search, scouting for a location, shooting and so forth, a good TV production does not come cheap. As is so often true in the audio-visual industry, the solution lies in co-production. The two science documentary experts – the BBC and the US Discovery channel – formed a partnership ten years ago. This co-operation enabled them to raise the kind of budgets required for an average production cost of €530 000 for a 52-minute documentary in the United Kingdom, compared with between €130 000 and €200 000 in France.

In the super co-production league, the series *Walking with Beasts* (6x30 minutes) on the evolution of mammals 65 million years ago, cost more than €11 million to make, and was jointly financed by the BBC, Discovery, Pro7 (Germany) and TV Asahi (Japan). It was more than two years in the making and

C'est pas sorcier

(France 3 – France)

A rare event on television: a science and discovery programme aimed at young people in their early teens. On board their travelling laboratory, Frédéric Courant, Jamy Gourmaud and Sabine Quindou take the youngsters off to strange and often spectacular locations, providing clear, fun and practical explanations on all kinds of subjects – from aluminium to amphibians, including the water cycle. *C'est pas sorcier* attracts a large audience, is also broadcast in Belgium and is available on video.

www.france3.fr/semiStatic/42-223-NIL-1651.html

Viden Om

(DR – Denmark)

Every week on the Danish public channel, *Viden Om* presents a series of short documentaries of between two and ten minutes in length, introduced by Anja Philip. It has covered a wide range of subjects over the past three seasons, including the human body and biology, technology, space research, archaeology and palaeontology.

www.dr.dk/videnom/

Jota

(Teleac/Not – The Netherlands)

A weekly 10-minute magazine programme aimed at the general public, Jota can be seen on the Dutch educational channel Teleac/Not. It covers a range of subjects with its resolutely educational approach, giving scientists the chance to speak for themselves, and presenting and analysing often little-known research subjects.

www.teleacnot.nl/sites/jota-tv/index.html

Reportrarna

(SVT – Sweden)

A bi-monthly magazine programme comprising scientific reports of interest to a wide public, *Reportrama* tackles major scientific issues, using a simple and direct language but always with the utmost discipline and with a penchant for investigative journalism.

www.svt.se/malmo/reporter/

employed a team of 80 (most notably at the two animation studios and for the special effects), plus transcontinental shooting in Indonesia, South Africa, Brazil and Mexico. This flagship series, which followed the equally popular *Walking with Dinosaurs* (€9.5 million), was also an opportunity to experiment with interactivity by giving more than 2 million British viewers the opportunity to find out more about the scientific issues raised and the production techniques used in making the series.

D

Derived media Internet complementarity is one of the new avenues being explored by most European science programmes. The viewer is invited to log on for access to a more in-depth content, references and links to explore the subject further. Some sites, such as the BBC website at www.bbc.co.uk/science, are starting to resemble a genuine online encyclopaedia – and are thus a particularly useful resource for teachers – sometimes with the option of a repeat viewing of a broadcast programme.

SuperQuark

(Italy)

It was back in 1980 that Piero Angela first had the idea of creating a major science programme worthy of prime-time Italian TV. First known as *Quark*, then *SuperQuark*, the form has changed but the goal remains the same: to raise the cultural level of the viewer by offering popular science of the highest quality. The many experts who contribute to the programme confirm its credentials. From ethnology to astronomy, archaeology, electronics and psychology included, *SuperQuark* casts its net far and wide. From the somewhat austere set, and never losing sight of the educational aspect, Angela has succeeded in his ambitions and currently attracts a weekly audience of 4 million, or 20% of the market.

www.superquark.rai.it/

Quarks & Co

(WDR – Germany)

The bi-monthly *Quarks & Co* concentrates on natural sciences, approached from different angles but always with a concern for simplicity and the knack of finding the most fascinating aspects of a topical theme. It offers a mix of field reports and studio sequences and tries to explain science at work in our everyday lives as well as considering some of the enigmas of the universe. 'Science as entertainment' is the motto of its presenter and producer Ranga Yogeshwar – an astrophysicist and researcher at CERN – who likes to feature experiments, graphs and computer animations. His overriding aim is to make complex phenomena understandable to the widest possible audience.

www.quarks.de/dyn/2095.phtml

Never short of ideas, the BBC has also launched a travelling exhibition based on its famous science programme *Tomorrow's World* (www/bc/co.uk/science/tw/2002). The aim is to make young people, their teachers and their families more aware of the latest news from the world of science and technology. During its trip around the UK it is expected to attract about 160 000 visitors. It will be an interactive event, covering research and innovation in the fields of health, energy, sports, transport, engineering and the life sciences. Launched as part of Science Year, this travelling roadshow will also broadcast live as part of the weekly BBC programme.

C

Cultural and thematic Over the past few years science has also begun to feature prominently on cultural or documentary channels. The Franco-German Arte channel, for example, devotes almost 20% of its programming to science subjects while France 5, a public channel launched in 1994, is essentially a knowledge channel. The latter aims to give viewers the tools to help them 'decipher the world around them' (www.france5.fr/sante_sciences/). In addition to programmes on employment, the economy, the arts, history and the media, science makes up one-third of its programming, with programmes for adults and children alike. With a predilection for the human sciences (40.1%), natural sciences (22%), and exact or technical sciences (16.5%), France 5 presents the mechanisms, advances and implications of research clearly and precisely in its magazine programmes, series, documentaries and debates. The weekly *A la recherche*, for example, adopts a tried and tested formula: a film followed by a debate.

In the private sector, the multimedia specialists Einstein Group launched an exclusively science channel two years ago. Einstein TV broadcasts quality programmes, combining information and entertainment, in fields such as space, technology, and the earth and life sciences. These usually comprise short sequences of between five and 30 minutes repeated at regular intervals, with the possibility of logging on to the Internet site (www.einstein.tv) for further information. Its programmes are broadcast by satellite in the UK (on Sky Digital), Germany (Mediavision) and Switzerland (Cablecom), and it hopes to expand throughout Europe by offering French, Spanish and Italian versions. The station is certainly not lacking in ambition in the face of European productions by the two major US channels, Discovery Channel and National Geographic. ●

The art of

A film-maker, producer, writer and director of science programmes at the BBC since 1991, David Filkin is one of those who has helped forge the reputation of the British public channel in scientific communication. The key to this success is the narrative.

What is a good science programme?

A useful programme – It is useful if it enables a certain audience to increase its understanding of science or in some way to gain insight into science. It may be a case of communicating knowledge, drawing attention to new issues or entertaining on the basis of science subjects – and there is no reason why the same programme cannot combine all three. The essential task is to communicate information. For that you have to both capture and hold the viewer's attention.

Do certain types of programme fulfil this function better than others?

All TV formats are equally suitable. *Life Story*, made by Mick Jackson, is a feature film telling the story of the race to discover the structure of DNA, eventually won by Crick and Watson at Cambridge. This emotionally tense human drama not only revealed the personalities of the scientists involved, but also made it possible to understand the structure of DNA. That is one way of approaching science.

Many documentaries cover science subjects in much greater depth while also including some clever story telling plus the human interest aspect. This can captivate audiences as effectively as the very best thrillers. Any science subject can make gripping viewing. As long as the human aspect of science is not ignored, and researchers are not reduced to the role of explaining impersonal data, any subject can make for a good television programme. The challenge for the producer lies in building a good story around somebody. That does not mean that the story cannot include notions of complexity and doubt, which are part and parcel of science. These elements can, in fact, be the most compelling aspect of a *science story*.

Horizon (BBC2 – United Kingdom)

The BBC's flagship science programme – which has run for almost 40 years now – *Horizon* tackles a variety of subjects (medicine, the environment, new technologies, archaeology, etc.) and is aimed at a mass audience. The programme combines an original form of narration with a solid scientific basis and concentrates in particular on the social implications of scientific progress. *Horizon* goes out at nine in the evening and regularly attracts 12% of the audience or over 3 million viewers.

www.bbc.co.uk/science/horizon/index.shtml

Dora Kastonopoulos in search of the lost city of Helike (*Horizon*). © BBC

Gândit in Romania

(TVR2 – Romania)

This magazine programme, which goes out at noon on Saturdays, aims to inform the general public about home-grown Romanian innovations. Among other things, it promotes discoveries and inventions which have won international prizes, with a view to helping them find practical applications. For 25 minutes researchers and innovators present the conception and development of their projects. This recently launched programme already attracts about 5% of the audience.

www.tvr.ro

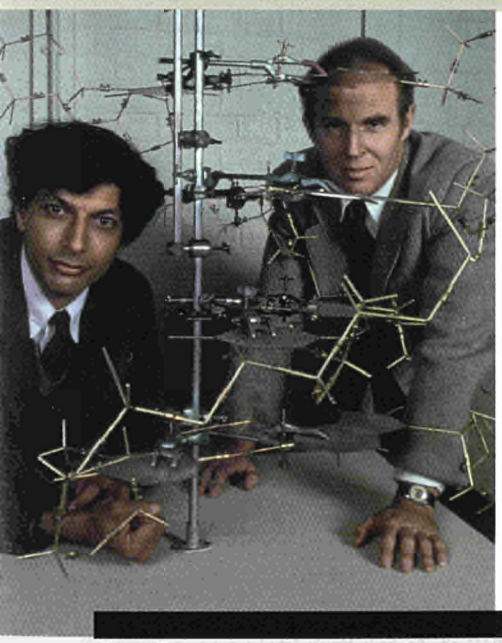
talking science

Nano – die Welt von morgen

(3sat – Germany)

This science programme goes out daily at 6.30 in the evening. It is co-produced by German (ZDF), Austrian (ORF) and Swiss (SRG) public television and covers a wide range of subjects, often topical and always handled skilfully. It is broadcast by the 3Sat satellite channel and can also be viewed on German regional channels at various times.

www.3sat.de/nano.html



Life Story – A film by Mick Jackson, produced by the BBC, tells the story of the race to discover DNA – finally 'won' by Crick and Watson – in the manner of a psycho-scientific drama verging on the thriller.
© BBC

Delta

(Hungary)

Launched in 1964, *Delta* is the science magazine programme on Hungarian public television. In the space of 25 minutes it presents a series of news reports and short documentaries on the latest developments in the world of science and technology. Its clear language and attractive presentation enable it to reach a wide audience.

www.mtv.hu/delta

The documentary produced by Simon Singh for the *Horizon* series, for example, dealt with a field as abstract as mathematics. The film opens with an interview with Andrew Wiles, the man who discovered the solution to Fermat's last theorem,(1) which had remained unsolved for centuries. He breaks down in tears as he tries to explain the significance of his finding. Most people who see this display of emotion remain glued to their sets to find out what this mathematical discovery was really all about.

The United Kingdom, and in particular the BBC, have a reputation of producing the best science programmes in Europe, if not the world. Why are they are so good at this?

We have a long tradition of training people to be specialists in all sorts of fields – including science – on which the BBC has built its expertise and reputation. Also, until recently, the budgets and opportunities available to these specialists were the envy of other broadcasters. But these funds are now decreasing. TV programmes now live or die by their financial viability, whether the backers are from the public or private sector. There are no longer unlimited funds, but that does not mean that you can no longer back talent. *Life Story*, which I have just mentioned, cost ten times more to make than a 30-minute magazine programme like *Tomorrow's World*. I do not believe the BBC was wrong to do this and I think it was a gamble worth taking.

(1) Fermat's famous great or last theorem states that if n is greater than 2, the equation $x^n + y^n = z^n$ has no positive integral solutions for x, y and z. This was proved recently (June 1993) by the English mathematician Andrew Wiles after 350 years of efforts and research by mathematicians worldwide (earning a generous recompense pledged in the 19th century by the French Academy of Sciences).

A channel portal

A European TV channel devoted exclusively to science is certainly an attractive idea. In March 2001 it received the backing of the ALLEA, the principal organisation of the European Academy of Sciences. 'Attractive, but unrealistic,' believes Kathleen Van Damme, senior consultant in audio-visual communication with DDB Focus Europe. She coordinated a feasibility study on the project, at the request of the European Commission's Research Directorate-General. The consultants studied the viability of and need for a European science channel, code named Athena, and concluded that a genuine audio-visual scientific press agency on the Internet would be more appropriate for current needs.

Kathleen Van Damme believes that the Internet is at present 'a more suitable tool for disseminating scientific information.' Rather than embarking on the somewhat risky enterprise of launching a new TV channel – in an already crowded market and with uncertain public financing – it is preferable to 'develop a genuine support policy for science programmes' which are already being shown on existing channels, by creating a specialised press agency which would also co-produce audio-visual programmes designed both for television and the web.

To this end, DDB Focus Europe[1] recommends that a database should be compiled of subjects relating to European research, including images, document files and bibliographical notices accessible on the Internet. Programme managers would be able to retrieve programmes and other material from this site. This 'dynamic multimedia and audio-visual' portal would also provide a forum for the exchange of scientific information allowing member television producers to pool their images and set up co-productions. It would have to meet the needs of professionals in terms of programme exchanges and information on these programmes (availability of rights, co-productions, grants for projects, exchange of good practice, etc.).

With the development of high-speed networks, this portal should be of interest to universities, research centres and teaching networks. The aim is also to provide a documentation service for young people looking for information on the Internet.

(1) Through the production of Video News Release and science documentaries, on behalf of the Research DG, DDB Focus Europe already circulates programmes and images which are available to European channels.

Encyclopedia

(France)

A window on every field of knowledge ... understanding the world, retracing the history of thought, investigating the great scientific enigmas. Curiosity is the watchword for the wealth of eclectic documentaries broadcast by this channel. Its flagship programmes are *Les exploits de la recherche*, which presents the past, present and future of science and technology, *La science en questions*, which focuses on a topical science subject, and *Côté science*, an educational programme on the major science subjects of our times.

www.encyclopedia.fr

Presented by Michel Chevalet, an overview of progress in micro-surgery, remote operations and gene therapy on the Encyclopedia channel.

Science

With its wealth of scientific resources, the Internet is an exceptional communication tool for professionals or mediators. New search tools are now also making it easier for the general public to navigate a path through this profusion of information. Two experts on this new mass medium, Jon Bing, of the Norwegian Research Centre for Computing and Law, and Robert Cailliau, a physicist at CERN in Geneva, share their thoughts.

'Although conferences, exhibitions and other events organised directly or indirectly by the scientific community have a role to play, it is from the media that members of the public obtain most of their scientific information.' This was the view expressed by Claude Birraux of the European People's Party on 25 January, addressing the Parliamentary Assembly of the Council of Europe in Strasbourg. Among the potential information resources, his *Report on scientific communication* gives pride of place to the Internet, which 'makes available to those interested a multitude of information on science subjects, explained at very different levels by researchers, individuals, laboratories, museums, universities, etc.' Is this simply a concession to the prevailing mood of the times or does the Internet really have a part to play in disseminating scientific information? If so, what are its distinguishing features? What sections of the population is it aimed at? Who runs the sites? And under what conditions could the web satisfy the hopes invested in it?

The benefit of immediacy

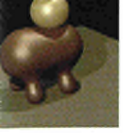
Jon Bing, of the Norwegian Research Centre for Computing and Law in Oslo, believes that the Internet is different to other media by virtue of its 'interactivity, which enables the web surfer to obtain information on subjects of his or her own choosing, although the search engines still need to be improved.' Robert Cailliau, a physicist at CERN (European Organisation for Nuclear Research, Geneva) and one of the co-inventors of the World Wide Web, believes that 'the Internet can also function as a meeting place as it is connected to electronic mail.'

The other distinctive feature of the web is the immediate availability of the information. You simply type on your computer keyboard and it appears on your screen. 'This is a key feature for most people who would not take the time to go to the local library to look for a book on science, even if they knew it was available,' stresses Jon Bing. He admits, however, that the absence of any survey on Internet use and the lack of a historical perspective prevents us from really knowing who uses the Internet, apart from the professional providers of scientific information whose working practices it has revolutionised (see *The media's medium* on page 25).

Dangers of excess

Paradoxically, the Internet's very accessibility, interactivity and abundance of information can be an obstacle to its use by the general public. How can the layman find his or her way around this huge resource and separate the good from the bad? 'The same questions were raised when printing was first invented,' points out the Norwegian researcher. 'The need now is to develop the navigating and guidance strategies – what we call meta-information – to enable us to take our bearings in a prolific environment, comparable to that of a large library. In Europe, these strategies have not been developed sufficiently to enable the correct use of the web, and in particular to determine what information is reliable. It will take time for solutions to emerge. Traditional librarians and documentalists will certainly have a pilot role to play in sorting out this chaos.' This is exactly what is happening, in fact, at the major US universities which provide remarkable scientific meta-sites, serving as directories and sending visitors to carefully selected sites on specific subjects, on-line libraries and learning tools (see box).

But of course you first have to know they exist. The surest way of finding your way around the web is therefore to consult other media which cover the subject. 'Ideally, the press could compile Internet orientation and navigation indexes. An announcement of scientific news would then be the occasion to go on the Internet to find out more,' believes Jon Bing.



on-line

US-style metasites

The main problem facing the Internet user trying to find scientific information is that of sorting through it all. By its very nature, the Internet provides access to pages proposed by the widest range of people and organisations - from the most respectable institutions to the craziest of individuals and including commercial companies guided by their own interests. So how can you find what you want? That is essentially the job librarians and documentalists do every day in the libraries of universities and other scientific institutions. Making the results of their efforts available on the web is therefore a natural solution - which is why major US universities have set up metasites, acting as genuine sorting houses with directories and science sites selected for their reliable content and classified per subject. They also often provide access to documents held by the library, downloadable courses and even educational tools.

Launched in 1990 and run since 1993 by the University of Berkeley (California), the *Librarians Index to the Internet* offers 'information you can trust'. The metasite operators have selected, and continue to monitor, more than 10 000 sites covering every field of science. At the University of Wisconsin, the team from the on-line publication *Internet Scout Project*, financed by the National Science Foundation, have 'scouted' hundreds of sites every day since 1994 and archived the best. Also worthy of mention is the *Directory of Internet Science Resources* operated by Georgia University Library.

The *Internet Public Library* of Michigan University seeks, evaluates and creates document bases for the general public, although its main activity is to study the problems the Internet poses for documentalists. Documentalists need tools too, of course, which is the reason behind the portal of the University of Lund in Sweden. This rather austere site is extremely rich, complex (complete?) and provides links to hundreds of other sites, metasites or specialised resources. It is a valuable tool for the professional.

Sites

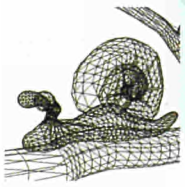
- Librarians index to the Internet
  www.lii.org/search/file/science
- Internet scout project
  http://scout.cs.wisc.edu
- Directory of Internet
  service resources
  www.libs.uga.edu/science/scires.html
- Internet Public Library
  http://ww.ipl.org
- For documentalists
  www.lub.lu.se/netlab/documents/
  lisres.html

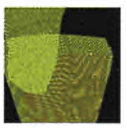
Sites in their own right Considerable investment is, however, required to launch a metasite or a general scientific information portal, if it is not to disappear rapidly. Robert Cailliau believes that 'a good popular science site should be seen as a museum. You need buildings, personnel, content, and new events all the time. It has to be *inhabited* and maintained on a daily basis. That takes a lot of effort and a number of full-time staff. Above all, I believe it must be approached as an end in itself. Too many sites, and especially science sites, are in fact a sideline of quite a different principal activity.' But a science site is not necessarily going to be profitable and, unless it has direct public funding, it must be supported by an institution – a university, research centre, museum, foundation or educational association, for example.

So is this lack of resources the reason for Europe's current shortage of general sites? As a public instrument for the dissemination of science, the Internet remains somewhat in the making in Europe. While accepting that better use could be made of it, Robert Cailliau is nevertheless confident, believing that it 'is certainly a vehicle of the future.' He would like to see the emergence of 'a European science site developed as an institution in its own right, independent, with a public education vision but also constituting a resource for teachers.' ●

Contacts

- Robert Cailliau
  robert.cailliau@cern.ch
- Jon Bing
  Norwegian Research Center for Computer and Law
  jon.bing@jus.uio.no
  www.jus.uio.no/iri/english/index.html





The illustrations which accompany this article are the result of efforts by a number of researchers, accessible on the Imagis site:
http://w3imagis.imag.fr/

As a general information source and support dedicated to their profession, the Internet has quickly become an essential tool for science journalists. Yet it remains one of many tools which, in principle, should not be a reason for failing to follow up on other sources, too.

The media's medium

To report on an event, you first have to know it has happened. Traditionally, science journalists, just like any other journalists, depended on contacts in the relevant circles, their address book and sometimes press agencies to cover news in their field – providing a necessarily partial view. The Internet changed all that, first by opening up a vast field of exploration, then by hosting services specifically designed for the media, often combining a website and e-mail. 'The difficulty of obtaining recent and, above all, reliable information on the discoveries of European research teams can be partly overcome by developing Internet services such as AlphaGalileo,' stresses Claude Birraux, author of a recent report on scientific communication for the Council of Europe. He is referring to the genuine on-line press centre, dedicated to European science, technology and medicine, and recently expanded to include the arts.

On-line press agencies AlphaGalileo – run by the British Association for the Advancement of Science and financed by a number of governments, foundations and scientific institutions in mainland Europe as well as by the European Union – aims to provide a counterbalance to US domination in the field of disseminating scientific information, as well as to the US tendency not to mention research carried out elsewhere. It gives professional journalists a factual view of scientific news through access to press releases and other news from all European players – research bodies, companies, governments, learned societies, press agencies, etc. – as well as the contact particulars of experts in various fields.

In addition to its portal which can be consulted at any time, AlphaGalileo offers a mail alert service automatically notifying any registered journalist of developments in his or her fields of interest. Although it is open to the general public, information still under an embargo is, of course, only circulated to professional journalists. The British journalist Colin Weeks says that 'a recent study showed that three-quarters of professionals find the service efficient, and 20% said it encouraged them to write more articles on European science and technology.'

A European site, AlphaGalileo supplements the American site Eurekalert. Journalists naturally use them both.

Rules of the trade The Internet gives the press the chance to discover a vast amount of scientific information from many different sources. Although the mix of genres and the difficulty of differentiating between reliable and less reliable sources can be an obstacle to Internet use by the general public, this is not, in theory, a problem for these professionals. They are most probably the biggest users of document resources such as fundamental databases compiled by scientists, bibliographical bases, the portals of academic institutions and other scientific bodies, as well as the valuable metasites of certain university libraries.

Direct access to information from a computer keyboard, whether circulated by on-line press services or obtained from databases, does not mean, however, that it is no longer necessary to apply the traditional methods of journalistic investigation. The Internet is a vital tool for scientific journalists, provided they continue to get out and about. ●

Sites

- Alphagalileo
  www.alphagalileo.org
- Eurekalert
  www.eurekalert.org

Virtually

By surfing the web, teachers can find more than 100 000 educational sites. From these they can obtain resources to improve their teaching alongside educational tools which their pupils can use directly – providing, of course, they know how to make the right choices.

All those involved in education agree – children have a natural appetite for knowledge and this desire to find out more should be stimulated from the very earliest days at school. So what does the web offer science teaching? Apart from an unrivalled document base for those who know how to use it, the Internet offers various tools which can generally be considered to fall into two categories: those which teachers consult outside the classroom to prepare their courses or improve their teaching practices, and those which pupils use during lessons.

As pupils are apparently losing interest in science, [1] teachers are turning to the Internet in the hope of bringing a new dynamism to their teaching. But where can they find the programme for a course on atoms and elementary particles for secondary school students, examples of practical activities to enable a class of ten-year-olds to understand how plants breathe, a site presenting the history of mathematics, or simply reference documents and illustrations? Cyberspace is packed with all this and more.

S

Separating the wheat from the chaff

It was partly to carry out such a selection that the European Schoolnet was launched in 1996 by about 20 European education ministries. This metasite gives the addresses of educational servers – in particular those selected by the main educational resource centres in the countries in question, generally run by the ministries – as well as examples of educational methods, news, and opportunities for teacher exchanges, etc. 'More than 120 000 educational sites are listed,' Thomas Maier, European Schoolnet's technical adviser, announces proudly. The general objective is to provide teachers with 'an overview of the educational use of the Information and Communication Technologies for Teaching (ICTE) in Europe.'

To find out more

- European Schoolnet
  http://www.eun.org/eun.org2/eun/fr/index.html
- International co-operation between schools:
  http://www.netdays2001.org/english/html/home/index.php
  http://www.thinkquest.org/index.html

Irish initiative

Students everywhere are abandoning science subjects. Ireland's university rectors decided to act and, this year, Science, Technology and Commerce Minister Noel Treacy officially launched a site presenting courses and research programmes at Ireland's universities.

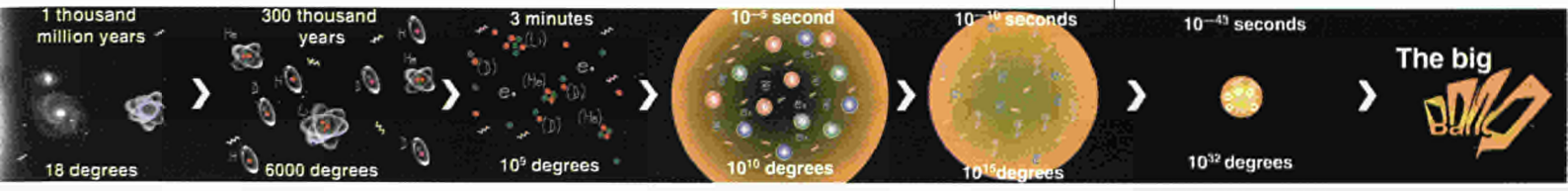
www.universityscience.ie/

On-line museums

Boston (Massachusetts), October 1998. During a meeting of the Association des centres scientifiques et techniques, Joël de Rosnay, director of the Cité des Sciences (Paris), launched the idea of setting up a European network which would link up science museums and the new concept science centres of which there are still relatively few in Europe. Ecsite (European Collaborative for Science, Industry and Technology Exhibitions) was born. Making intense use of the Internet, the network has expanded worldwide and now includes 240 science museums in over 35 countries. It provides a forum for the exchange of information and experiences as well as for co-operation between specific projects. Ecsite's Internet portal includes a directory of the websites of all the member institutions and, as such, is a valuable point of entry for a curious public.

Visitors can also see *Bionet*, Ecsite's first on-line exhibition. The idea of using the web to create 'virtual museums' rather than simply museum sites is not new. The National Museum of Science and Industry in London has made it a speciality – its site now offers around 20 permanent 'events.' In the United States, the Smithsonian Institution, a grouping of Washington's science museums founded a century and a half ago at the initiative of the British scientists James Smithson, also proposes many virtual visits which often follow on from 'real' exhibitions (such as *Ocean Planet*, an exceptionally comprehensive exhibition on the sea, presented a few years ago).

educational



Posters and explanations of the big bang created by Cern.

Many countries are also trying to set up resources adapted to their own educational system. 'In Norway, the government is planning to compile a *national knowledge base* for schools,' explains Jon Bing, of the Research Centre for Computing and Law in Oslo, and there are probably similar initiatives elsewhere. Nevertheless, he stresses that 'there remains a great deal to be done' when you compare what Europe has achieved with the scientific metasites of certain major US universities (see box on page 23).

Classroom practices and limitations With on-line exercises or experiments, educational games, and questionnaires, there is a growing trend for websites to offer tools which pupils can use directly. 'We have one or two computers connected to the Internet per class and we use them every day,' explains Jaana Minkkinen, head of the Risti primary school in a small village in eastern Finland. Classroom *Internet sessions* can nevertheless quickly reach the limit of their usefulness, especially with older pupils. Alain Ritman, who teaches maths at a French *lycée*, believes that 'it is mainly the best students who benefit most from this. The others amuse themselves but do not get much from it.' More ambitiously, teachers can use the web's interactivity and electronic mail to allow classes located in different countries to work together on a common scientific project, or even have pupils develop their own educational sites. The Americans are very partial to these *science fairs* and other competitions. The Europeans are beginning to follow suit, but more in the spirit of co-operation than competition.

(1) See RTD info special issue on Sciences and Young People, *November 2001.*

The first internal pacemaker was implanted into American Paul Zoll in 1952 at St George's Hospital.
© Science Museum/ Science & Society Picture Library

Leila Campbell Taylor as seen by Lewis Carroll in 1879 - Negative belongs to the National Museum of Photography, Film & Television (London).

Electronic game about space.
© Science Museum/London

Sites

- Ecsite
  http://www.ecsite.net
- Bionet
  http://www.ecsite.net/bionet/
- The National Museum of Science and Industry
  http://www.nmsi.ac.uk
- NMSI on-line science museum
  http://www.sciencemuseum.org.uk/on-line/exhibitions.asp
- Smithsonian Institution
  http://www.si.edu/
- Ocean Planet Exhibitio
  http://seawifs.gsfc.nasa.gov/ocean_planet.html

As a means of breaking free from the traditional path to scientific publication through accrediting by peer review, many researchers want to see the immediate publication of scientific information on the Internet, free of charge and available to all. The initiatives are increasing, provoking the start of a debate with previously uncompromising publishers.

Web Utopia?

Sites

- Arvix
  http://www.arvix.org
- CCSD
  http://ccsd.cnrs.fr
- PubMed Central
  http://www.pubmedcentral.nih.gov/
- Public Library of Science
  http://www.publiclibraryofscience.org/
- Initiative for open access to research
  http://www.soros.org/openaccess/

Electronic forums on the subject:

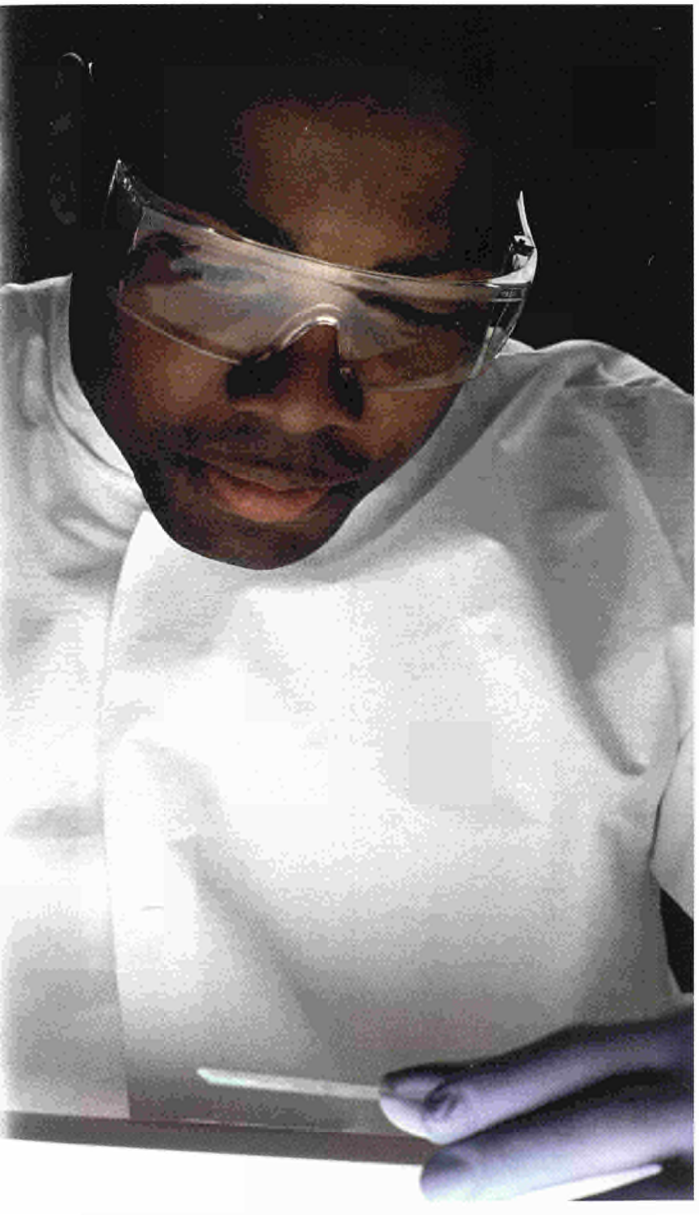
- Nature
  www.nature.com/nature/debates/e-access/index.html
- Science
  www.sciencemag.org/cgi/eletters/291/5512/2318b
- American Scientist
  http://amsciforum.amsci.org/archives/september98-forum.html

Over the past decade the Internet has been the battlefield for the dissemination of basic scientific knowledge – from which any popularisation of science is ultimately derived. Articles written by and for researchers are published by specialised journals, but only after the process of peer review. Stevan Harnad, professor of cognitive sciences at Southampton University's Faculty of Psychology in the United Kingdom, estimates that 'there are currently at least 20 000 journals with reading committees in every discipline, publishing more than 2 million articles a year.' No academic library, however rich, can acquire and archive such a mass of information. Scientists therefore have unequal and always partial access to what must be the basis for their work. The problem is particularly acute in the developing countries (see box). There is also, of course, the matter of the general public and science communicators.

Success in physics In response, recent years have brought a series of initiatives based on Internet technology with the aim of providing 'free, universal and immediate access to scientific information' for all, to quote Frank Laloë, physicist at the Ecole normale supérieure in Paris. In 1994, for example, Paul Ginsparg, a physicist employed at the Los Alamos national laboratory in the United States, launched a free server named Arvix, to which physicists send their articles, sometimes even before they are published in a science journal. It was an immediate success. 'Arvix now contains about 150 000 articles and is consulted 120 000 times a day,' says Frank Laloë who heads the Centre pour la communication scientifique directe (CCSD), inspired by Arvix, and set up in 2000 in Villeurbanne, France. 'We want to generalise and internationalise Paul Ginsparg's idea, and are working on the long-term conservation of archives which will not be easy given the inevitable changes in technology,' he explains.

Bio bargaining In the field of life sciences, it was Harold Varmus, director of the US National Institutes of Health, who got the ball rolling in 1999. His idea was for a website providing not just articles already published in biomedical journals, but also texts submitted directly by researchers, the site having its own reading committee. Launched in 2000 with the support of the very popular PubMed/Medline service, PubMed Central provides free access to the contents of several dozen journals. However, the most prestigious among them are refusing to co-operate. Frank Laloë encountered no such resistance in the field of physics, however, where he believes that 'publishers are onlookers and do not participate a great deal. Ultimately, this kind of base will be a useful tool for them too.'

Last year, US biologists launched the idea of a single computer base making available free of charge to everyone all scientific and medical literature six months after publication. The *Public Library of Science* campaign to boycott journals which refuse to co-operate collected the signatures of over 30 000 scientists worldwide.[1] The initiators set up a non-profit-making organisation with the plan to publish electronic journals free of charge, although this has yet to produce a concrete result. The debate resurfaced again – less confrontational this time – in December 2001 in Budapest. The *Initiative for open access to research*, backed by the foundation set up by the billionaire Georges Soros, wants to create archives open to all, including the 'simply curious', and to encourage researchers to place their articles on the servers of their own institutions. A virtual global base would be created by adopting joint indexing standards and developing search engines.



Traditional publishers are now beginning to pay attention to such initiatives, as witnessed by the electronic forums opened by the two most prestigious general science journals, *Science* in the United States and *Nature* in the United Kingdom. 'Changes to the system of academic publishing are inevitable and necessary,' admits Declan Butler, Europe correspondent with *Nature* and organiser of the forum. He believes that 'all those involved in scientific information are now living in a phase of experimentation.'

Information for developing countries

'Those who could benefit most from science and technology are also those with the least access to information on these subjects.' That is the view of the organisers of SciDev.Net, a website launched in December 2001 and financed by the Department for International Development (DFID – UK), the Research Centre for International Development (CR – Canada) and the Swedish Agency for International Development Co-operation (ASDI). The site is run by David Dickson who used to work for the British magazine *Nature*, and presents dossiers combining news and more in-depth information on subjects 'at the science/technology/sustainable development interface.'

While it is no doubt essential to report on such subjects, isn't the priority to provide access to basic scientific information for researchers and engineers in these countries, something they are prevented from doing by the high cost of subscribing to 'primary' journals? This is one of the arguments put forward by scientists who have been calling for several years now for free and universal access to fundamental articles (*see Web Utopia?*). The same thinking is behind the launch, by the UN Secretary General in September 2000, of the Health InterNetwork initiative, with the aim of providing equal access to health information. It is managed by the World Health Organisation and supported by a group of international organisations, NGOs and private foundations. The Internet portal started up in 2002, placing on-line and free of charge the content of more than 2 000 medical journals, databases, information systems and other tools, for use by universities, medical schools, research centres and other public institutions in some 70 developing countries. The initiative also aims to establish or improve Internet access for public or private non-profit-making organisations in these countries.

- SciDev.Net: www.scidev.net/
- Health InterNetwork: www.healthinternetwork.org

(1) See RTD info *no.31*, Trouble in cyberspace.

Interesting sites

Communicating science

Science uses a precise, highly mathematical language, often with a specialised vocabulary. When researchers communicate between themselves, it can take a form which would defy even the most committed 'amateur.' The job of the mediators (journalists, teachers, etc.) is to make this knowledge accessible to the general public. But how? The Internet is full of websites explaining how to write a clear and understandable article. The Research Directorate-General has compiled a directory of many of them, including journalists' associations and scientific institutions. These tools seem to be aimed primarily at scientists themselves who are aware of the difficulty of explaining their work – something they are being called upon increasingly to do by the bodies which employ them. Some of the sites are designed more specifically for journalists and report on scientific progress in a given field.

- http://europa.eu.int/comm/research/science-society/science-communication/links_en.html

All seeing...

The Royal Society, founded in 1660, now operates an Internet site with a genuine scientific 'monitoring' role, casting its net far wider than events in the United Kingdom alone. Features include a diary of events, a booking service for conference seats, reports on the latest debates between science and society, and details on scientific prizes and research grants. The Royal Society also organises seminars and debates at which reputable researchers are invited to explain their work, especially in controversial fields such as cloning.

- http://www.royalsoc.ac.uk/

The science help line

Launched in 1994, Science Net in the UK is a freephone service answering callers' questions on science matters (+44 (0)808 800 4000). It is now available on the Internet and includes a directory of scientific sites and contacts with specialists.

- www.sciencenet.org.uk/

Science fairs and competitions

What better way of learning about sciences than choosing a technical, environmental or scientific question, trying to find the answer with your classmates and then presenting your findings in public at a science fair? That is the principle, coupled with the inevitable competitive dimension, of the many science fairs being held in schools throughout the US. By using the Internet, whether when making their investigations or presenting their results, co-operation is also possible with classes on the other side of the country.

Rather than presenting a technical project – by solving a problem, building a device, or preparing an exhibition – participants can also create an educational Internet site. That is the goal of Think Quest, an association which works mainly but not exclusively with schools. It currently has links worldwide with scientific library sites created by pupils in Denmark, Italy, the Netherlands, Sweden and Switzerland.

- Internet science and technology fair http://istf.ucf.edu/
- Practical guide to the IPL http://www.ipl.org/youth/projectguide/
- Think Quest http://www.thinkquest.org/

Bio-medicine

Located on the campus of the US National Institutes of Health, in Bethesda (Maryland), the National Library of Medicine is the world's biggest medical library. Its on-line service Pubmed provides access to the Medline database containing over 11 million documents. Visitors to the site can find all a researcher's published works or all the fundamental articles on a given subject, whether medicine, biology or the life sciences in general. Each result includes the full article reference and summary, sometimes even the full text – depending on the agreement Pubmed has reached with the publisher – and a link to the publisher's site for the full article, either at a price or free of charge depending on the publisher's policy (*see Web Utopia?*). Pubmed/Medline has become a daily working tool not only for researchers but for all journalists covering biology, medicine or related subjects.

Private sites propose special search engines for the Medline base in line with specialised interests, such as Medscape for doctors.

Pubmed/Medline

- www.pubmedcentral.nih.gov/

Who are we?

This educational and interactive space, taking the web surfer on a trip through time to the origins of man, is the work of the Institute of Human Origin. It boasts an educational document, a dictionary of scientific terms, teaching tools and an impressive array of links on the subject of prehistory – from palaeolithic art to methods of scientific investigation.

- http://becominghuman.org/

Spotlight on radioactivity

It was for *Monsieur Tout-le-monde* ('The man in the street'), as its home page states, that researchers at the CNRS decided to create a website on radioactivity. Why? Because radioactivity is natural, is part of our everyday lives, gives rise to some little-known applications (in health care for example) and is the subject of rational and irrational fears. This is a good example of scientists who have decided to shed light, in simple terms, on the kind of questions many people have about a field which causes them some concern.

- www.laradioactivite.com

Giulio Giorello –
'Science and technology are a culture, and culture, in the widest meaning of the term, must confront other cultures – or it risks becoming a vanquished culture.'

Giulio Giorello, a researcher, philosophy of science professor at Milan University and mathematician, is one of Italy's leading figures in the philosophy and communication of science. He is also adviser and collection editor with the Raffaello Cortina publishing house. RTD info spoke with this committed bibliophile.

Books which star the test of time

You carry out research, you teach and you are active in scientific publishing. What is the common denominator of these different activities?

They are three distinct activities and to be successful in any one of them it is certainly not necessary to practice the other two. That said, I also believe that a university professor can only teach a subject to which he or she is truly committed. The subjects you lecture on best will be those you are most interested in and there is a link between education and research. As to publishing, I see it as an excellent means of getting to know other researchers and of becoming more familiar with approaches which may differ from your own. It is an extremely useful way of putting your own ideas to the test and comparing them with the ideas of others.

What do you see as the role of a scientific publisher?

I should first like to make it clear that I am not head of a publishing house but am an editor in the Anglo-Saxon sense of the term, in my case of the *Scienza e idee* collection. I believe that in many cases publishing has done what school was unable to do. In Italy, for example, publishers and scientists have worked together to produce books such as the *Enciclopedia della Scienza e della Tecnica*, the fruit of co-operation between Alberto Mondadori and Ludovico Geymonat, or the translation of the writings of Edmund Husserl, who was discovered as a result of the collaboration between Enzo Paci and Alberto Mondadori. There are publishers who are able to take sometimes considerable financial risks. Some have proved to be visionary.

In this civilisation of the image – and of the virtual – what is the fate of the written word?

I think that when the means of communication changes, the content of the cultural message changes, not just the form. Without the invention of the printing press, two crucial events for modernity, namely Protestant reform and modern science, would not have materialised. Luther and Galileo understood the importance of this technical advance.

Today, even though there are new forms of communication and content for scientific publishing, such as the compact disc, I would be very careful before proclaiming the death of the book. I do not believe there is, at present, an Internet site which has the same power of attraction as a published work of quality. A book with quality illustrations and typography is also a beautiful object. You can appreciate the odour of the paper and the finish of the binding. Printing is an art and I never feel more at home than in the company of books.

But that does not prevent you from using your computer...

Of course not, but the interface with a computer is cold and difficult to manage. I use a computer and the Internet when I need information. But the computing tool does not replace Joyce's *Ulysses* printed on paper, although it can replace the telephone directory.

Science can reach a wide audience through books, but how can a complex subject matter be presented without over-simplification? How can it be effectively popularised? And who should take on the task?

There is a magnificent example of popularising by a scientist which is *The Evolution of Physics*, written by Albert Einstein in co-operation with Infeld. This is proof that it is possible to treat difficult subjects with perfect clarity. It is incorrect to assume that popularisation leads to a debasement of scientific culture. Science is knowledge destined for the general public and the principle of communicating this knowledge is an essential element of the discovery itself. Galileo understood this in his *Dialogue Concerning the Two Chief World Systems* which, in many respects, is also a popular work.

Some popular works, moreover, have become references – such as the amusing mathematical brainteasers Lewis Carroll presented to his young readers. Publishing houses and their various collections all have their specific identity and are mutually complementary, offering popular works, educational works, works of theory, biographies of scientists, etc. Readers are interested in many subjects and people enjoy reading about science if it is well presented.

'Readers are interested in many different subjects and they enjoy reading about science, if it is well presented.'

Is it easy to find authors – whether scientists or otherwise – able to 'translate' science for a wide public?

It is not difficult to find authors. On the other hand, what is more difficult is to find competent translators, partly because of the sometimes precarious economic circumstances in which they work. There are certain major cultural traditions – in particular in German and English – in which quality popularisation and scientific education are deeply rooted. Many foreign authors are published in the *Scienza e idee* collection. A good example is *Le trame dell'evoluzione* by Niles Eldredge, which in a way achieves a synthesis of Darwin and the principal ideas of contemporary geology by transposing the concept of evolution to the study of the earth and our environment.

But, of course, we also work with reputed Italians, such as Umberto Bottazzini, a mathematics historian and excellent populariser of science, the physicist and now biologist Edoardo Boncinelli, expert on the history of medicine and health institutions Giorgio Cosmacini, and many others. We also make room for less renowned scientists. It is sometimes interesting to bring together a young researcher and a renowned professor.

Scientific publishers can also turn to classical authors whose works merit being made available to the public and can even open up new avenues for us. There are certainly a lot of new works to be discovered, past and present, for those publishers who are ready to take a gamble.

Do the sales of some works allow you to take a chance with others, as is the case in other areas of publishing?

Of course. One of the tasks of an adviser to a publishing house is to convince his bosses to invest in authors who may not be instant best sellers but whose books will stand the test of time. A few years ago it was a gamble to publish Karl Popper, and when publishers such as Raffaello Cortina or Jaca Book decided to publish Jacques Deridda, who has now become essential reading, they needed the courage of pioneers.

Do European scientific publishers co-operate between themselves?

Sometimes. I have mainly had the pleasure of working with French, German and British publishers and I believe they valued the experience too. I have also had particularly positive relations with Portuguese publishers, a country which is showing increasing intellectual dynamism and courage. Ireland is also very interesting. No doubt there will be other opportunities in the future. Just think about the wealth of Russian culture and the scientific tradition and depth of reflection found in the Baltic countries.

Publishers, aware that a user-friendly website has become an absolute must, also know that the Internet can be an excellent marketing tool for their printed books and magazine.

When Gutenberg enters cyberspace

'Just as the tools used by scientific research are changing, so too are the tools of scientific communication,' claims the very powerful Elsevier publishing house on its Internet site. The site offers an impressive number of on-line publications, research tools per discipline, access to the full text of works (paysite), and a 'contents alert' service allowing those who register to receive the tables of contents of the journals of their choice by e-mail. Since 1995, a newsletter – designed principally for librarians and other book professionals – also provides the latest news on Elsevier publications and other events.

This is far from an isolated example. The Internet is also opening up many doors for Dunod of France, a 'knowledge' specialist for the past 200 years and now part of the Vivendi group, and likewise for Springer in Germany, founded in Berlin in 1842 (now 86.5% owned by Bertelsmann), which publishes 2 600 titles a year and has a stock of about 19 000 books, 60% of them in English. For traditional scientific publishers, new publishing houses, universities and research centres alike, there is nothing 'virtual' about the Internet. It is a vital new media in which they must invest.

Inflation? In the world of magazine publishing, the cost of paper is rising, the number of subscribers falling and the only way to maintain circulation is by concentrating on virtual access. This has not, however, prevented an almost unbridled increase in the number of print magazine titles, with a 207% increase between 1986 and 1999.(1) In March 2000, there were approximately 3 000 on-line magazines produced on the basis of paper versions (including 689 on medicine and 165 on physics) out of a total of 8 511 virtual magazines. One no longer speaks of subscriptions but of various kinds of 'site licences' – for institutions or groups of institutions, or for individuals.(2)

Electronic publishing not only makes it possible to consult the articles, whether free of charge of otherwise, but also to track down other sources of knowledge through a document search, links, interactive services, electronic commerce, etc. The websites, in fact, operate as a marketing service for mass circulation scientific journals – such as *New Scientist, La Recherche, Scientific American* – attracting potential readers to the printed versions.

However, this wealth of information of every possible kind also raises a number of questions, especially ethical ones. There has been a lot of talk about access to information and free information, but there are other issues too. Richard Smith, editor-in-chief of the *British Medical Journal*, wonders, for example, about the changes the virtual dimension is bringing to medical information. He set out his ideas at the second International Conference on Electronic Publishing in Science organised by the International Science Council and Unesco in February 2001.(3) He believes the fact that 'doctors and their patients can have immediate access to the same information' can change their relationship which becomes more egalitarian and is no longer of the 'master-pupil' variety (although a distinction between information and a command of information remains necessary). Moreover, the circulation of details of treated cases, in which a patient can recognise himself and be recognised by others, is a very different matter when these details are 'read' by 500 people or made available on an Internet site where they can be consulted by everybody.

(1) According to David Shulenburger of the University of Kansas (USA).
(2) See Liblicence (www.library.yale.edu/~llicense/index.shtml) and the European Bureau of Library Information and Documentation Associations (www.eblida.org/ecup/)
(3) See www.unesco.org/science

Disseminator of ideas

Other kinds of publisher, such as Odile Jacob in France, use the Internet to participate in educational programmes. Its multimedia department has teamed up with Jeulin, a specialist in teaching aids, and the école des Mines to launch tools designed for primary school classes as part of a national operation entitled 'La main dans la pâte.' One example is 'L'eau dans le quotidien' (Water in daily life), a CD-Rom with a teaching kit, designed for teachers. In addition to the 'practical' questions of science, the videos teach children to read, think and discuss. This valuable tool was developed in co-operation with Nobel prizewinner Georges Charpak.

www.odilejacob.fr/

Seeing is

The *Horsehead Nebula,* situated in Orion, obtained from three exposures by the FORS2 multi-mode instrument on one of the telescopes at Paranal (Chile) belonging to the European Southern Observatory (ESO).

believing?

'Besides finding the colours beautiful or the shapes intriguing, it is perhaps necessary to be aware of the scientific reality, too. It is a question of evaluating what all these images can contain by way of information or open up in terms of further inquiry. When they are exhibited to the public, the appreciation varies depending on whether or not they are specialists in the field. Everyone gets something different from them,' explains Michel Depardieu, of the Scientific Information and Communication Department at the French National Institute for Health and Medical Research (Inserm) in Paris.

The images he is speaking of are part of the travelling exhibition entitled *When science meets art* which, over the past three years, has given the general public the chance to see the scientific images produced by Inserm researchers. The exhibition is constantly on the road, travelling from continent to continent, from Beijing to Quebec, by way of Houston and New Delhi. 'I wanted these scientific photographs, which really stimulate the imagination, to enable those who know nothing about research to immerse themselves in this environment.' The images – placed in context by means of photos of the researchers in their laboratories, explanatory captions, introductory text, etc. – were selected both for their aesthetic value and their ability to appeal to the general public.(1)

The public has proved receptive just about everywhere. Scientific *imagery* is beginning to be a part of our culture. Press and television have accustomed us to the abstract beauty of the earth captured by satellite and the streaks of light analysed by astrophysicists. The rods of the Aids virus and the searching heads of sperm cells have attained a symbolic value. But what is the meaning and nature of these images?

Their colours, their shapes and their perspective are all illusions of the real, just like our own vision which has always been deceptive. Due to a slight deflection of light by the atmosphere, the stars are not where we suppose them to be. The sky is not blue and the way we perceive colours (to a degree of course) is individual. The brain encodes the luminous energy transmitted by the retina and recreates this world in three dimensions in accordance with the perspective of the Renaissance artists who placed man at the centre of the world. Roads narrow in the distance. The darker a chasm, the deeper it appears to be. When inverted, the same image can show the foot of a canyon or mountain peaks. 'We must therefore admit that the image we have the impression of seeing does not exist. It is a visual fresco, a creation, the product of a compromise between our neurons and our retina,' explains Patrice Lanoy.(2)

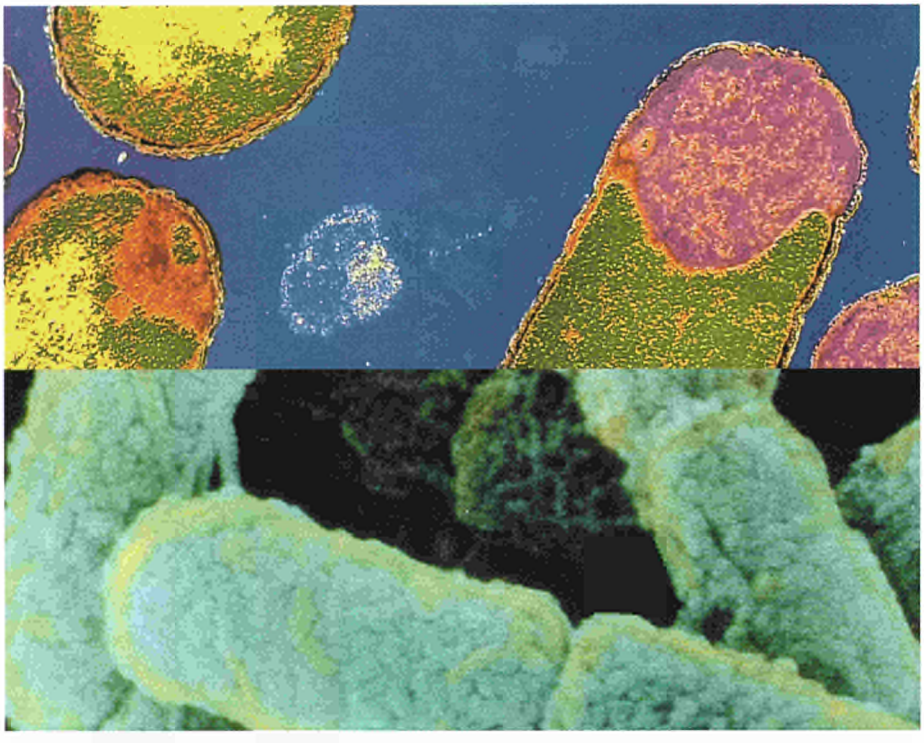
Also, the technologies used by science are revealing more and more of what is invisible to the naked eye: microscopes, X-rays, magnetic resonance imagery, infra-red and the traces of elementary particles all provide us with indicators – indicators which fascinate. In informed circles at the beginning of the century, it was all the rage to have 'one's picture taken' by X-rays, for example. Complete silhouettes of transparent subjects were produced by William Morton in New York, among others.

These indicators also constitute increasingly fundamental tools of research, even if they do not correspond to reality. Images – beginning with the very modest diagram – have always accompanied science, strengthening an approach or a description, illuminating a message or concept and facilitating communication. 'Science affirms that its material images are a portrayal of the physically invisible of which they constitute a proof when they are also the portrayal of the mentally invisible, the regaining of a freedom lost since the advent of modern science, namely the relationship of the senses to things,' explains Monique Sicard (CNRS – France).(3)

The shape of salt crystals will appear rounded to a varying degree depending on the technical setting on the machine which captures them. The same object 'seen' by an electron microscope set to scan or transmission mode will differ considerably. But scientists have long needed an image in order to work – and to convince. 'Science has always produced two kinds of image: reconstitutions of the real destined for a scientific process, and icons, designed to influence a relatively uninformed public of decision-makers and media,' writes Patrice Leroy, who condemns our so-called image society which is increasingly being invaded by icons.

(1) Contact: Michel Depardieu – mdepardi@infobiogen.fr
The Inserm image bank: www.serimedis.tm.fr
(2) See Patrice Lanoy, Invisibles – Images de l'inaccessible,
Editions de la Cité des Sciences et de l'Industrie, Paris, 1998.
(3) Monique Sicard, Les paradoxes de l'image, *Hermès no.21, CNRS Editions.*

The technicalities



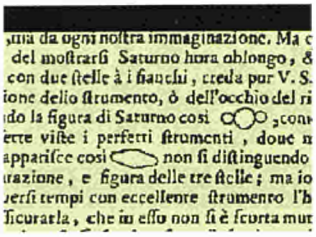
The *Escherichia coli* bacteria, photographed using two different techniques, assumes aspects which at first seem to bear little similarity. The transmission electron microscope gives a cross-section of its interior while the scanning electron microscope produces a 3D image.

When photographs in the field of cellular biology (*in vivo* cells or coloured histological cross-sections) are obtained by optical microscopy, the intensity, contrast and colour saturation depend on a number of conditions (lighting, temperature, exposure time, UV light, etc.) as well as the balance of the colour temperatures. In the case of fluorescence or specific marking, the colours obtained are largely determined by the reactions produced or the use of a particular wavelength. Images observed directly by digital files on a computer screen correspond to given values which permit the representation of localisation. They could also be processed in the form of density (grey-scale).

In the case of a transmission electron microscope (TEM) or scanning electron microscope (SEM), the image obtained is always in black and white, with varying degrees of contrast. The use of filters and the intensity setting will influence the colour temperature, and thus its final rendering. The fact that some of them are presented in bichromy is an artefact.

Photographic emulsion is sensitive to wavelengths and contrasts and is able, depending on the exposure times, to record phenomena that cannot be detected by other means, such as *in situ* hybridisation or radioactive markings. Depending on whether or not filters are used, the intensity setting will affect the colour temperature and thus its final rendering.

As Michel Depardieu explains, 'digital imaging is more than just a change of technique or support. It brings changes to research activities and information processing. The image can be changed, or its content manipulated, in a way which not only changes the image but the relationship to the image.'



The image assists words and concepts. Even a graph, such as in this edition of *Istoria e dimostrazioni intorno alle macchie solari* (Rome, 1613), enables Galileo to explain what he would subsequently call the rings of Saturn. This drawing was presented at Image and Meaning, organised by the Massachusetts Institute of Technology in Cambridge, USA and comprising an exhibition, conference and debates. Felice Frankel, a researcher and scientific photographer, believes that 'good photographs grab people's attention and a good image can help scientists and the general public to understand things more easily.'

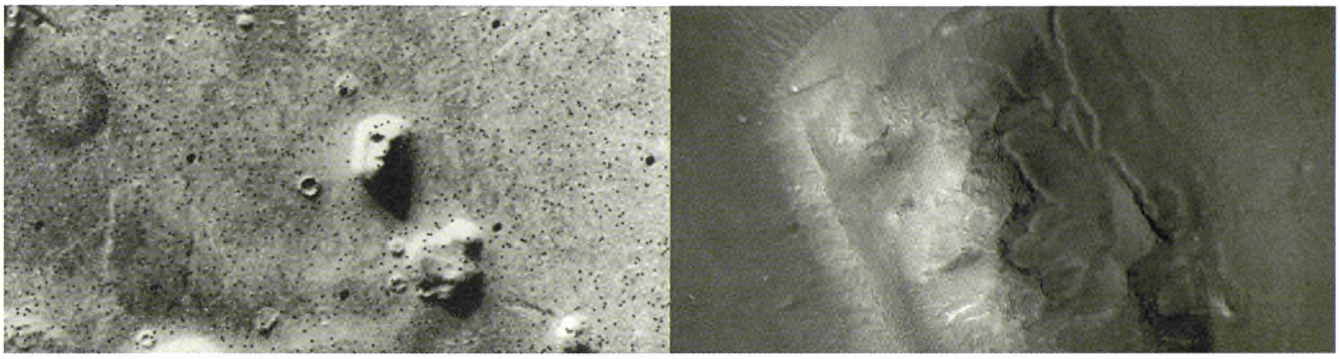
http://web.mit.edu/i-m/conference.htm

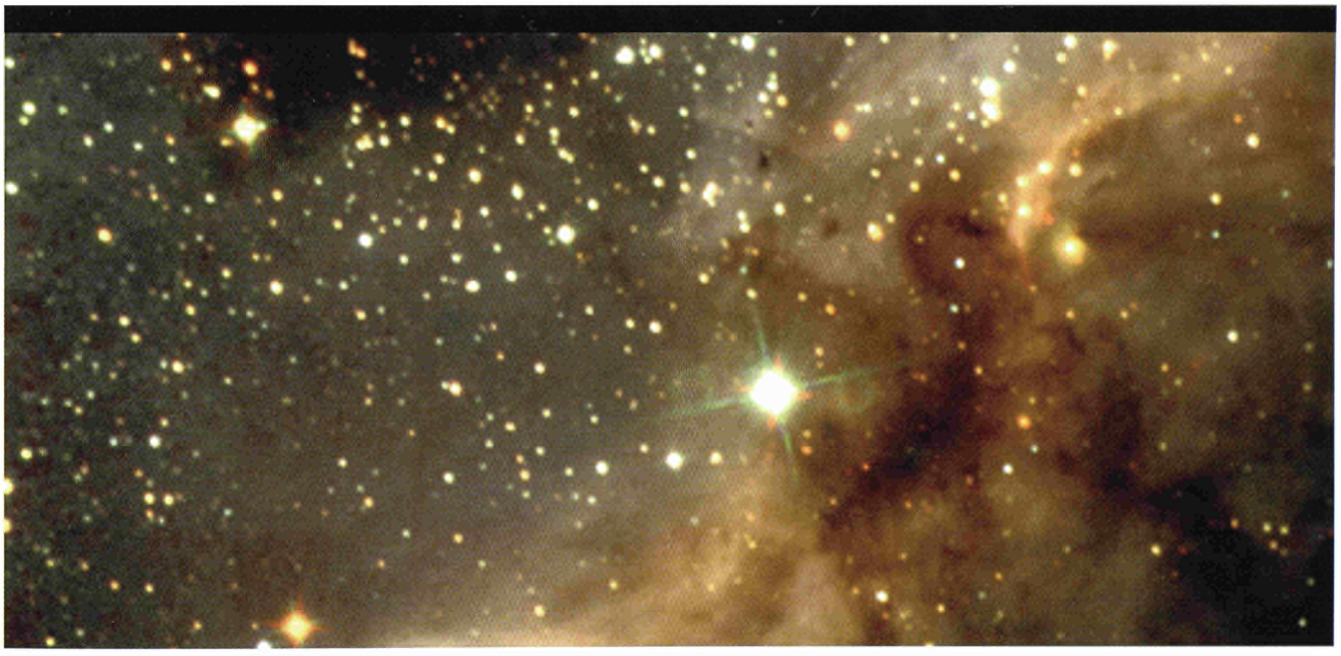
'In a problem, it is the most elegant solution which is the right one, the one which works. I have often observed how the beautiful works better than the ugly...' (Roger Penrose, British mathematician who worked with the astrophysicist Stephen Hawking and 'inventor', in 1973, of a paving system with no repeat pattern consisting of six parts – which seem like four – to amuse a hospitalised friend).

Humanoid or mineral?

Images sometimes lend themselves to fiction and confusion. The story which caused the most excitement is that of *The Face*. In 1976, the Viking spacecraft was investigating the surface of Mars and among the photographs sent back to Earth was one of a 'face' discovered at a site known as Cydonia. NASA circulated the image, accompanied by a clear press release: 'a rock formation, in the centre, which resembles a human head, formed by shadows creating the illusion of the eyes, nose and mouth.' A section of the public seized upon it immediately. The Red Planet could be home to 'humanoids'! Soon people were seeing a pyramid and other traces of civilisation around the face, interpreting it as proof of a message sent to the cosmos. It was not until 1988 that another NASA probe provided the proof (through an image...) that when depicted under a different light this relief looked nothing like a face at all. In the meantime, the story had fuelled many people's imaginations, caused a lot of ink to flow and generated more than one website.

NASA Face website
http://science.nasa.gov/headlines/y2001/ast24may_1.htm





'No astrophysicist, no astronomer, awards rational scientific value to the false perspectives of composite images or to the false colours of images of the planets. No physicist awards analogical value to the bumps on the surface of an object seen through a tunnel-effect telescope and supposed to show atoms. Yet they act as if this were the case...
(Monique Sicard, Laboratoire Communication et Politique, Paris, CNRS)

Above, the stars in the Omega nebula observed through the New Technology Telescope at the European Southern Observatory's (ESO) in La Silla, Chile.

'When you are a researcher, photographer or artist, you tell yourself that you are seeing things for the first and last time. It is a question of succeeding in capturing time, life, and death, even if it is that of a cell,' says Michel Depardieu, director of Inserm's Department of Photography. It is to him that we owe this selection of 'snapshots' of an invisible world of research.

Snapshots of an invisible world

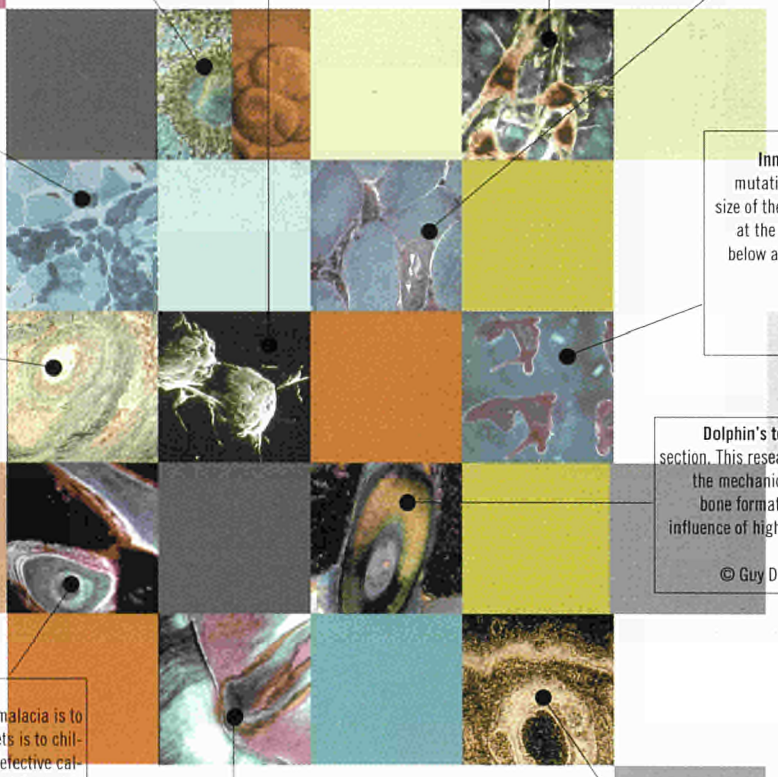
Fertilisation – On the left, the mature human ovocyte – Measuring 1/10th of a mm, this female egg possesses 23 chromosomes. Fertilisation by a sperm cell gives rise to an embryo containing the full complement of 46 chromosomes (23 pairs). On the right, this embryo is two days old, after *in vitro* fertilisation. It is composed of four cells resulting from the second division after fertilisation and dead sperm cells can be seen stuck to the periphery.
© Jacques Testart/Inserm

Aids – The HIV virus, seen on the surface of the cell in the background, is in the process of fusing with an uninfected cell in the foreground. Budding from the surface of an infected cell, the virus can infect neighbouring cells.
© Jean-Claude Chermann/Inserm

Brain – The brain contains about 100 billion neurons, forming a kind of cable network on this image, with their projections (axons and dendrites). The neurons shown here are in the brain stem, the part of the brain that connects to the spinal cord.
© Jean-Patrick Guéritaud/Inserm

Lesions – Muscle fibre lesions (visible on this skeletal muscle biopsy specimen) sometimes develop in patients infected by the Aids virus. The damaged cells are red, while normal cells are blue.
© Michel Fardeau/Inserm

Gene therapy – Cross-section of skeletal muscle. A gene expressing a blue-stained protein was introduced into muscle precursor cells or myoblasts. The aim of this gene therapy research is to reconstitute normal muscle tissue in patients with wasting diseases. Note the brown-stained end-plates.
© Jean-Thomas Vilquin/Inserm



Inner ear – Effect, in a mouse, of the mutation in a developmental gene on the size of the bones of the inner ear. The bones at the top are of normal size, while those below are from mice bearing the mutation and are much reduced n size.
© Piotr Topilko/Inserm

Atherosclerosis – A fatty deposit in the intima, the internal layer of an artery. The formation of this plaque or atheroma reduces the inner calibre of the artery and limits blood flow. The resulting condition, atherosclerosis, is the main cause of death in industrialised countries.
© Jacky Larrue/Inserm

Dolphin's tooth – Cross-section. This research concerns the mechanical aspects of bone formation under the influence of high atmospheric pressure.
© Guy Dalcusi/Inserm

The Inserm images

The French public research institute Inserm proposes an on-line catalogue of around 40 000 images (18 800 of which relate to man, health and the environment), 500 videos on hospitals, 30 hours of microcinema on cell life and 2 700 biological terms accompanied by 1 400 figures and animations. Known as Serimedis, this server, which presents the work of hundreds of researchers, is also home to the iconographic collections of the Institut Pasteur, the Institut de recherche et développement (IRD), the Paris Health and Hospitals Authority and Museum of Medical History. It also boasts an electronic biology encyclopaedia known as Bee. There are around 8 000 subscribers to Serimedis (which is free of charge), on every continent, in particular from the world of research, teaching and media.
www.serimedis.tm.fr

Rickets – Osteomalacia is to adults what rickets is to children. It is due to defective calcification of the protein matrix of bone tissue. Examination under polarised light shows an abnormal proportion of pink uncalcified protein matrix within black calcified bone.
© Pierre-Jean Meunier/Inserm

Cavity – Due to decalcification of the enamel or dentine, a cavity results from the destruction of the tooth surface by bacteria which, by decomposing sugars, attack the enamel.
© Bertrand Kerebel/Inserm

Encoding gene – This image show a membrane protein that ensures sodium ion transport in epidermal cells. In the kidneys, this canal plays a major role in regulating sodium exchanges. Its recent discovery in the skin raises questions as to its role in this tissue.

All the pictures presented on this page are details of scientific images.