issue 6 | June 2009

CAP journal

Communicating Astronomy with the Public

Around the World in 80 Telescopes

24 Hours Around the Main Observatories On and Off the Earth

Journalists and Astronomers

Tips for Talking to Journalists

Outreach Sessions Through a Lens

Engaging Scientists in the Communication of Science

THE UNIVERSE YOURS TO DISCOVER
INTERNATIONAL YEAR OF ASTRONOMY 2009

IAU

www.capjournal.org

Colophon

Editor-in-Chief
Pedro Russo

Executive Editor
Lars Lindberg Christensen

Editors
Terry Mahoney
Anne Rhodes

Assistant Editors
Lee Pullen
Catherine Moloney

Layout and Production
André Roquette
Pedro Russo
Mafalda Martins
Martin Kornmesser

Contributors
John H. Schwarz
Guy Consolmagno
Ian Robson
Marta Entradas
Steve Miller
Thomas Baekdal
Douglas Pierce-Price
Simon Lowery
Michaela Emundts
Andreas Wojtaschek
Mike Simmons
Lars Lindberg Christensen
Pedro Russo
Pamela L. Gay
Fraser Cain
Phil Plait
Emily Lakdawalla
Jordan Raddick
Matthew McCool
Ryan Wyatt

Web Design and Development
Raquel Shida

IAU DIVISION XII, Commission 55: Communicating Astronomy with the Public Journal Working Group
Lars Lindberg Christensen
Rick Fienberg
Andrew Fraknoi
Richard de Grijs
André Heck
Terry Mahoney
Steve Miller
Paul Murdin
Pedro Russo
Sidney Wolff

Thanks to
Britt Sjöberg and Julia Westner

Published by
IAU DIVISION XII Commission 55: Communicating Astronomy with the Public

Sponsored by
ESA/ST-ECF and ESO

CAPjournal Communicating Astronomy with the Public Journal
ESO ePOD
Karl-Schwarzschild-Strasse 2
85748 Garching bei München
Germany

E-mail:
editor@capjournal.org

Phone: +49 89 320 06 195
Fax: +49 89 320 2362

ISSNs
1996-5621 (Print)
1996-563X (Web)

Contents

Submit articles for one of the following journal sections:

- **Announcements**
- **Reviews**
- **News**
- **Resources**
- **Innovations**
- **Research & Applications**
- **Letters to the Editor**
- **Opinion**
- **Best Practices**
- **Interviews**

www.capjournal.org

Online issues
Free subscriptions
Article submission

Cover: Around the World in 80 Telescopes splash screen. Credit: ESO/L. Calçada.

Editorial

A scientific conference is an opportunity for researchers to present, share and discuss their work and findings. Together with scientific journals, conferences are the most important channel for the exchange of information between researchers. Besides providing a forum for discussion and the sharing of ideas to the education and public outreach (EPO) community, conferences also provide a way to bridge the gap between our community and fellow scientists.

Over the last few years, mainly due to the International Year of Astronomy 2009 (IYA2009), several astronomical conferences have incorporated EPO sessions in their programmes. In this CAPjournal issue, EPO sessions take the limelight: Marta Entradas and Steve Miller provide background information about EPO sessions at scientific conferences and examine the recent European Planetary Science Congress. Ian Robson and our regular contributor Ryan Wyatt report on the IYA2009 session at the European JENAM2009 and on the Astronomy Visualisation Workshop 2009, respectively. Also, Pamela Gay and friends share tricks and tips on how to use new technologies to bring online audiences into the conference rooms together with the scientists and professionals.

Last April we enjoyed a good example of how new technologies help us in our duty to share scientific achievements with society at large. For the first time, and in the framework of IYA2009 and its Cornerstone project 100 Hours of Astronomy, 80 world-class astronomical research facilities were linked in a webcast, called "Around the World in 80 Telescopes". Over the course of 24 hours, astronomers, engineers, educators and communicators shared their findings, discoveries, and the hi-tech machines that peer into our Universe and provide clues to understand, it with over 170 000+ people. Our feature-length article will give an insider's view into the processes that went on behind the scenes to produce this impressive webcast.

Also in this issue, Brother Guy Consolmagno shares useful hints for working with journalists, Matthew McCool gives us some techniques for explaining the cosmos in a clear way and Thomas Baekdal helps us connect with our audiences in the new media jungle...

Between issues you can stay in touch through our website, www.capjournal.org, where you will find the current issue in PDF format, an astronomy communication and education job bank, submission guidelines and back issues.

We also welcome astronomy and science communication events (conferences, meetings, etc.), training opportunities, job postings or courses offered. If you have astronomy and science communication-themed products such as books, DVDs, television programmes, magazines or websites that you would like to see reviewed by the CAPjournal editorial team, simply send the necessary information to: editor@capjournal.org. This is also the address to send any questions, comments or opinions. We'd love to know what you think!

Happy reading,

Pedro Russo
Editor-in-Chief

Explained in 60 Seconds

A collaboration with *Symmetry* magazine, a Fermilab/SLAC publication

What is elementary particle physics?

Physics has demonstrated that the everyday phenomena we experience are governed by universal principles applying at time and distance scales far beyond normal human experience. Elementary particle physics is one avenue of scientific enquiry into these principles. What rules govern energy, matter, space, and time at the most elementary levels? How are phenomena at the smallest and largest scales of time and distance connected?

To address these questions, particle physicists seek to isolate, create and identify elementary interactions of the most basic constituents of the Universe. One approach is to create a beam of elementary particles in an accelerator and to study the behaviour of those particles — for instance, when they impinge upon a piece of material or when they collide with another beam of particles. Other experiments exploit naturally occurring particles, including those created in the Sun or resulting from cosmic rays striking the Earth's atmosphere. Some experiments involve studying ordinary materials in large quantities to discern rare phenomena or search for as-yet-unseen phenomena. All of these experiments rely on sophisticated detectors that employ a range of advanced technologies to measure and record particle properties.

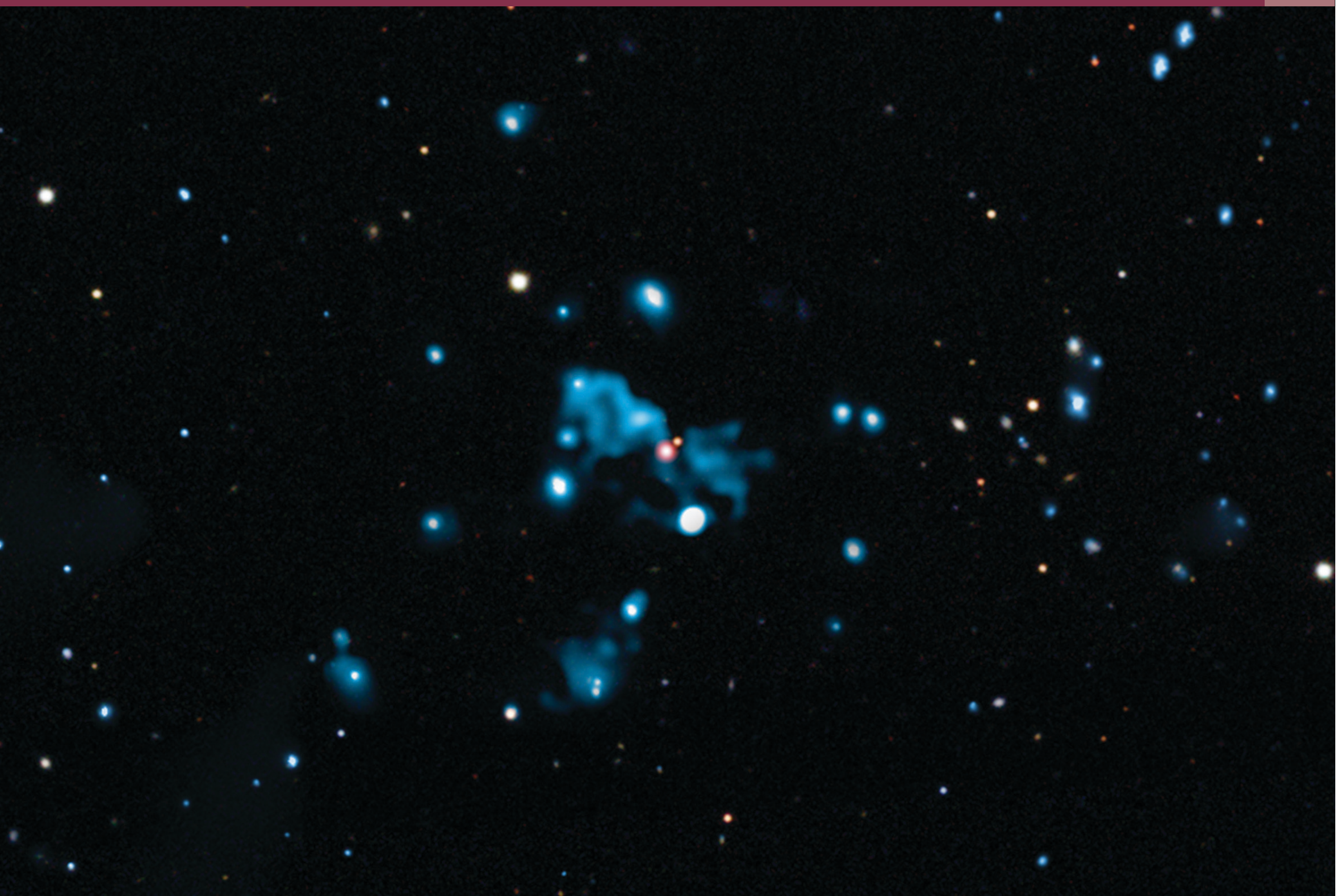
Particle physicists also use results from ground- and space-based telescopes to study the elementary particles and the forces that govern their interactions. This latter category of experiments highlights the increasing importance of the intersection of particle physics, astronomy, astrophysics, and cosmology.

From *Revealing the Hidden Nature of Space and Time: Charting the Course for Elementary Particle Physics* (2006), Committee on Elementary Particle Physics in the 21st Century, National Research Council.

Key Words

Written Communication
Case Study

This is a composite image showing a small region of the Chandra Deep Field North. The diffuse blue object near the centre of the image is believed to be a cosmic "ghost" generated by a huge eruption from a supermassive black hole in a distant galaxy. A deep image from the Chandra X-ray Observatory, and in red is an image from the Multi-Element Radio Linked Interferometer Network (MERLIN), an array of radio telescopes based in the United Kingdom. An optical image from the Sloan Digital Sky Survey (SDSS) is shown in white, yellow and orange. Credit: X-ray (NASA/CXC/IoA/A.Fabian et al.); Optical (SDSS), Radio (STFC/JBO/MERLIN).



Journalists and Astronomers

Guy Consolmagno
Vatican Observatory
E-mail: brother_guy@mac.com

Key Words

Journalism
Interview
Media

Summary

Professional astronomers often have to interact with journalists and other representatives of the media. This brings a whole host of difficulties, but the process can be beneficial for all parties. The author, being from the Vatican Observatory, is no stranger to media interviews and some hard-learned lessons are passed on here.

The talents needed to do science are often quite distinct from the talents needed to explain science. The best scientists are not necessarily the best interviewers or popularisers. Sometimes, of course, they are …, but we can't all be Richard Feynman or Carl Sagan.

Still, it is important that someone does the interviews. Our astronomy takes money; and the money comes from the general public, in one way or another. The people who ultimately pay our salaries, and give us the cool hi-tech tools to work with, deserve to know what we've done with their resources.

While it is claimed that the space programme gave us Teflon (not true, by the way) or that astronomy improves the gross national product by encouraging young people to become engineers (a stretch, but with an element of truth), those aren't the reasons why astronomers are paid to do astronomy. Our culture supports our work because, ultimately, we are here to feed a common human hunger to know. In a real sense, a part of our work is in the entertainment business. The cool photos of the Horsehead Nebula satisfy something in the human soul. But the Astronomy Picture of Day stuff is like the flashy top-ten song that makes you go and buy the CD; the hope is that eventually you'll also listen to the more subtle, but ultimately more beautiful song further down the list… which in astronomy would be, say, the details of plasma physics that explain the colours of the nebula. I think the physics is even more beautiful than the image, but it takes a lot of work to get there.

Thus we come to the frustrations of media interviews. You, the scientist, have a wonderful story to tell. But explaining it may make you sound like the guy who can't tell a joke, who gets tangled up in the details and never gets to the punch line. And you have little control over how it gets told. You're at the mercy of an interviewer who, if they ever took even one university level science course, probably didn't do very well in it. I speak as someone who has had to try to teach astronomy to journalism students.

From the journalist's point of view, of course, life is no easier. This crazy science story that their editor told them to cover is one of five completely different stories that they have to pretend to be experts on today. And it's probably on a topic they hated, because they never understood it when they had to take it in college. Worse, the editor doesn't want it good; the editor wants it now. Stories are the filler between the advertisements, and today's newspaper will be lining the bird cage tomorrow. I also speak as someone whose first career choice was to be a journalist, working three summers as an intern on a newspaper before I learned that it was easier to do astronomy than to interview strangers.

So the path of least resistance is to dredge up the same clichés. If a phrase has been used so often that it has become trite, then it probably means it won't offend anybody and so it is safe to use again. And hearing it over again brings a certain comfort of familiarity to the audience. Who cares if it isn't true, or even logically self-consistent? Of course, this actually means that there is an opportunity here for both the astronomer and the journalist. If the astronomer can come up with a new soundbite, everyone's life is a lot easier. The journalist has a story; the astronomer has a chance to actually sidestep an old established half-truth. (And create your own new cliché!)

But the burden is on us, the astronomers. Writing a popular version of our science is as much work, and just as important to do, as writing up a scientific paper. It takes a special set of skills. If you aren't good at it, admit it: and ask for help. And give help if asked for it.

I'm the glib one at my observatory. I know that it; that is one of my jobs here. Also, at the moment, I am the only native English speaker in our Rome headquarters, which is an issue when half the interviewers coming here work in English. That is why I am often the designated one to talk to the press. But that's also why I have wound up, for instance, recently writing half a dozen articles about cosmology — including the entry for the next edition of the Catholic Encyclopaedia — even though my field of astronomy, meteorites, is about as far from the Big Bang in space and time as you can find in astronomy. That may also be why I am not a bad choice for such articles. I am far enough removed to see the forest for the trees, to see the shape of the story that an outsider — like me — finds interesting; but at the same time I am close enough that I can ask the real experts and have a chance of understanding what I was getting wrong, and how to put it right.

It's easy to complain — as I too often do — that reporters keep asking us the same questions. That's like complaining that every year, first year students keep making the same mistakes! In fact, it is an opportunity. Every time I am interviewed, I have my own comfort in knowing what is likely to be coming, and knowing from experience what sort of answers work. Like a vaudeville performer who's done the same act for years, I know how to pace the story, which details can be skipped over, where the laugh lines are. But to take advantage of this opportunity, to tell the story well, means having a clear idea of what the story is. Why is our research really interesting? What is the "punch-line" to the story that the average journalist, and reader, can appreciate? What are the essential bits to set up the story, and which details can I leave aside when I tell the story?

I remember the first time a bit of science I had done was written up in a popular journal. The journalist had seen (as I did not see at that time) the bigger context that made my little bit of scientific work relevant to the bigger questions in my field. The journalist had understood my own work better than I did! Since then, I have always tried to keep in mind just exactly why I am doing the science I do. Keeping a clear idea of the bigger picture makes it much easier to explain my little contribution to a journalist; it makes me a better interviewee. And by keeping me focused, this also makes me a better scientist.

Biography

Brother Guy Consolmagno is the curator of meteorites at the Vatican Observatory. He has an extensive academic background and has written more than 100 scientific publications alongside numerous books. He is blogging as part of the International Year of Astronomy 2009 Cornerstone project the Cosmic Diary. His posts can be read here: http://cosmicdiary.org/blogs/brother_guy_consolmagno/

Reviews

The IYA2009 in Europe at JENAM 2009

Ian Robson[1]
UK Astronomy Technology Centre
E-mail: ian.robson@stfc.ac.uk

Figure 1. The four children from the Meden School and Technology College: Warsop, Nottinghamshire — Niall Evans, Joshua Cantrell, Chloe Johnson and Laura Simpson (left to right) alongside Bridget, Astrium's EXOMARS Rover prototype.

The European Week of Astronomy and Space Science was marked by the combination of the UK National Astronomy Meeting (NAM) and the Joint European National Astronomy Meeting (JENAM), both held at Hatfield in the UK from 20 April through 23 April. Symposium Seven was devoted to the International Year of Astronomy (IYA2009) in Europe, with outreach and education as the key themes. Contributions were allocated to one of five 90-minute sessions (plus posters) and all were all extremely well attended, with a full house of around 60 participants on two occasions.

The first session focused on the international aspect of the IYA2009 and was led off by Pedro Russo (the International Coordinator), who gave an overview of all the activities and the state of the financial support and supporting organisations. This was followed by presentations about three IYA2009 Cornerstone projects: 100 Hours and 80 Telescopes Around the World (Douglas Pierce-Price); Portal to the Universe (Lars Lindberg Christensen) and She is an Astronomer (Helen Walker). The latter two Cornerstones had their international launch during the NAM/JENAM meeting. Everyone agreed that the "80 Telescopes Around the World" event had been a spectacular success and great appreciation was shown to all those involved in its organisation and delivery. The "behind the scenes" snippets from Douglas showed what a truly professional event this was and how complex the organisation had been. Many thanks are due to ESO for the technical support. The demonstration of the Portal to the Universe, a one-stop, astronomy news and products web showed what a tremendously powerful tool this is and it is very clear that it will be a valuable asset for the future and will have a great legacy beyond IYA2009. She is an Astronomer brought lots of discussion about gender balance and bias, which continued well after the session.

The remaining four sessions focused on national IYA2009 activities and education. Presentations were given on IYA2009 activities from the following countries: United Kingdom, Armenia, France, Romania, Slovenia, Slovakia and Serbia. Other presentations focused on specific activities, mostly in the UK and were wide-ranging. One of the UK ventures was the production of a short film – *"The Starry Messenger"*; a story about Galileo and his observations of the Jovian satellites along with a moral for the student of today. The producer, Robert Priddey of the University of Hertfordshire, gave a very honest and humorous review (including many outtakes) of what it took to make the project happen. The film was given its first showing at the meeting and will be distributed to schools throughout the UK. For those interested in obtaining a copy, contact production team at thestarrymessenger@gmail.com.

In the education section, two of the IYA2009 Cornerstone projects were reviewed: UNAWE (Carolina Ödman) and the Galileo Teacher Training Program (Rosa Doran). There was lots of audience discussion on both of these topics. We also heard about a wide range of educational activities in Benin, Spain and the UK. The highlight of the education session was organised by Mrs Tina Sherwood, a local schoolteacher, where four 11–12 year old schoolchildren gave very impressive and assured presentations about their project work on archaeoastronomy.

A new Cornerstone project was announced at the meeting — an autumn version of the 100 Hours of Astronomy. This will be held on 23–24 October and will concentrate on sidewalk astronomy and telescopic viewing of the Moon and Jupiter. The audience voted overwhelmingly to call this event "Galilean Nights" and this suggestion has been adopted by the IAU Executive Working Group.

Overall it was clear that a huge amount of work is going on globally, and especially in Europe, to promote IYA2009. All the sessions had extensive discussion both during and afterwards as people swapped ideas. A great meeting.

Notes

[1] On behalf of the JENAM2009 IYA2009 Symposium Organising Committee: C. Ödman (The Netherlands), I. Robson (Edinburgh, UK), P. Roche (Cardiff, UK), P. Russo (IAU/ESO) and M. Stavinschi (Bucharest, Romania)

EuroPlaNet Outreach Sessions Through a Lens:
Engaging Planetary Scientists in the Communication of Science

Marta Entradas
University College London
E-mail: m.entradas@ucl.ac.uk

Steve Miller
University College London
E-mail: ucapt0s@ucl.ac.uk

Key Words

Conferences
Science Communication
EPO Sessions

Summary

Although European scientists are active in space sciences and technology, comparatively little effort is being put into communicating space achievements to the public. While the American National Aeronautics and Space Administration (NASA) is well known in Europe, its counterpart, the European Space Agency (ESA), is poorly recognised. The need to seek strategies that will help forge relationships between the research community and European citizens has been recognised by numerous bodies, and initiatives to move public engagement further are, for many, now part of their activities. EuroPlaNet, the European Planetology Network, is an example. Among other activities, EuroPlaNet organises an annual scientific meeting, the European Planetary Science Congress (ESPC), which covers a wide range of planetary and space science topics, and also incorporates outreach sessions where professionals of science communication can discuss and share best practices. This paper will explore the contribution of outreach sessions to strengthening the relationship between science and society. We present here an overview of the sessions during the period 2006–2008, and discuss our views on the value of outreach sessions at scientific conferences.

Introduction

Space technology and activities have an increasing and important value in our lives. One might expect to see a public that is generally well informed and supportive. Studies aimed at understanding the public's general knowledge and attitudes to space activities show that there is a general awareness of space science and technology. But European citizens, specially the young, have little knowledge about space issues, and more precisely of European space programmes and achievements (Ottavianelli, 2002; Jones, 2007). Harriet Jones (2007) showed that, when asked to list space exploration organisations, less than 0.5% of the British 13–15 year old students involved in the study listed ESA. This is despite the strong participation of the UK in the Mars Express mission and the publicity given to its (albeit failed) Beagle 2 lander, as well as the Cassini mission to Saturn and its (highly successful) Huygens probe, to give just two recent, high profile examples. (See Jergovic and Miller, 2008, for a review of the UK press coverage of these missions.)

Although the level of detailed knowledge is lower than might be expected, given the extensive press coverage, "astronomy and space" is one of the areas that attracts a great deal of public interest. Indeed, when comparing the Eurobarometer survey results from 2001 and 2005, the most significant rise in interest by the public can be observed for "astronomy and space", which has increased from 17% to 23% of Europeans saying that this is an area that interests them.

One of the main reasons identified for the poor awareness of space matters is the lack of good communication by those directly involved in science. For example, in 2007, *the Space Policy Journal* stated that "Space agencies and public outreach — must try harder" (Brown, 2007). The same issue discussed a series of recommendations for an "active strategic communications effort" by space actors to engage the public more and then enhance support for space exploration (Finarelli and Pryke, 2007). Furthermore, the tendency in Europe is for planetary and space scientists and engineers to talk only with their peers and not to get their message across to the public. It seems that Americans are far more efficient in communicating space sciences than their European counterparts (Lorenzen, 2007). Even though the promotion of the public understanding of science is now recognised in Europe as part of a scientist's professional duty, and national governments and several governmental agencies are involved in it (Royal Society, 1985; Gregory and Miller, 1998; European Commission, 2001; European Commission, 2007) it seems that communication does not come immediately to the minds of European scientists. It is worth saying that Europeans believe scientists put too little effort into informing the public about their work; however, they are still regarded as the best qualified to explain science to society (Eurobarometer, 2005).

One indicator of these differences in the attitudes towards public communication between the US and Europe is the enormous discrepancy between the number of images of the European Mars Express mission and the American Phoenix mission made available on the dedicated websites for each of the missions. After almost five years of operation, a mere 549 of ESA's Mars Express images are online, against the 35 560 images that the Phoenix mission released to the public in the five months of operation of its lander[1]. According to the opinions of European museums and planetarium operators polled by ASTRONET's Infrastructure Roadmap (Bode 2008), images and videos relating to astronomy and space are needed, and a "central repository of visual material" would be of special interest to them. The importance of producing interesting and high quality communication products is recognised by ASTRONET as one of the best ways to improve the communication–cultural differences between the US and Europe.

Detailed reports have called for the development of sustained programmes of public engagement with space science. In May 2007, the Global Exploration Strategy (Framework for Coordination, 2007), a vision for robotic and human space exploration, agreed that space exploration is a "global partnership in service of society", and that a programme to engage the public and encourage students is vital. National governments have also shown interest by publishing their own civil space strategies. For example the UK Civil Space Strategy Report (2008) states that "improving public understanding of science is a top-level government objective".

As an answer to this demand, many individual and governmental bodies have been designing schemes to encourage scientists to communicate more with the public. An example is the strategy employed in Britain by the Research Councils, particularly the Science and Technology Facilities Council (STFC), which is responsible for such scientific areas as space and astronomy, in supporting their research grant holders in their public engagement work (grant awards schemes, support for communication skills training courses, delegation of scientists as schools liaison officers, and involvement of PhD students with schools and the public). By many measures, it is worth noting that this strategy has generated a notable increase in both the number of scientists communicating and the number of activities in the recent past (Pearson, 2001). Another example is the programme of training courses on science communication skills already adopted by numerous countries such as Portugal, the UK and Australia. This is also found at a broader level. The European Commission (EC) has been very supportive of public engagement. A case in point is the ESConet Trainers project, which organises workshops in science communication for EC-funded scientists[2]. Indeed, the EC made has made outreach a *sine qua non* for funding and science communication is now an essential ingredient in any EC-funded project. EuroPlaNet[3] is an example. It was created in 2005, with the aim of supporting and gathering planetary scientists together; but it also integrates initiatives to improve the public understanding of planetary environments.

EuroPlaNet

One of the widely perceived failings of the planetary sciences in Europe is that the community is very fragmented, divided along national boundaries, and tending to look towards the United States for partners. This is despite the existence of the European Space Agency, which is becoming increasingly important as a focus for space missions and European team-building. The European Commission funded project, EuroPlaNet, set out to build an organisation that could achieve the long-term integration of planetary sciences across Europe. In its second year (2006) EuroPlaNet inaugurated an annual European Planetary Science Congress (EPSC). EPSC is a vital "dissemination platform", aimed not just at planetary scientists in Europe and elsewhere in the world, but at the "users" — industry, politicians and the public at large.

EuroPlaNet also undertook to develop engagement between European space and planetary scientists and the public at large. The network sponsored the production of several outreach products, products that can be found on the EuroPlaNet website[4]. EuroPlaNet's outreach team decided that there should also be outreach sessions dedicated to public engagement activities at the EPSC. Although this is not a new approach, the incorporation of outreach sessions in scientific congresses can be seen as part of a process of "redesigning" scientific meetings over time.

Outreach sessions at scientific meetings

The "redesign" of scientific meetings has been very effective in strengthening relations between science and society. It has often picked up on ideas that go back to the early days of the 19th century, when science was starting to come into its own. For example, right from its foundation in 1831, the British Association for the Advancement of Science (BAAS) combined scientific sessions with lectures aimed at the general public, which were given by notable scientists of the day such as Michael Faraday, John Tyndall and Thomas Henry Huxley.

The American Association for the Advancement of Science (AAAS), now the world's largest scientific society, is renowned for its annual meetings, attended by more than 10 000 participants every year. When it was founded in 1848, the idea behind the AAAS annual meeting was similar to that of the BAAS. Somewhere along the way, the "public" side of the meeting was lost: in 1951, the AAAS Board criticised it as being too scientific and "old-fashioned" and recommended that the Association focus renewed attention on the relations between the public and science (Arden House, 1951). In 1955, Warren Weaver, the then president of the AAAS, pushed the meetings to take on a new role in reaching out the public, and since then the meetings have been a major event for the host city, strongly focused on the general public.

The example of the BAAS and AAAS annual meetings has, belatedly, been adopted by Europe. In 2004, ESOF, the EuroScience Open Forum, held its first biennial meeting. Like the BAAS and AAAS, ESOF has a very broad scientific programme, with many public events (Enserink, 2004). The meeting has been successful, with an increase in the number of sessions and participants, both scientists and non-scientists, since it started: 1300 participants in 2004 in Stockholm, and some 4500 in Barcelona in 2008 (Enserink, 2008). The scheme has been adopted by others and public events are now common at broader scientific congresses. This can merely be an evening event for the local community scheduled outside of the main congress programme.

Incorporating outreach sessions into more narrowly focused scientific meetings provides places where science communication professionals associated with the scientific discipline in question can meet for discussions and share best practices. This is happening more and more at meetings that discuss issues of high public interest, such as the environment. And astronomy and space sciences have also taken a lead and held outreach sessions at major meetings. Examples are the American Astronomical Society (AAS) meeting, the Astronomical Society of the Pacific (ASP) meeting, the International Astronomical Union General Assemblies (IAU GAs) and the International Astronomical Congress (IAC).

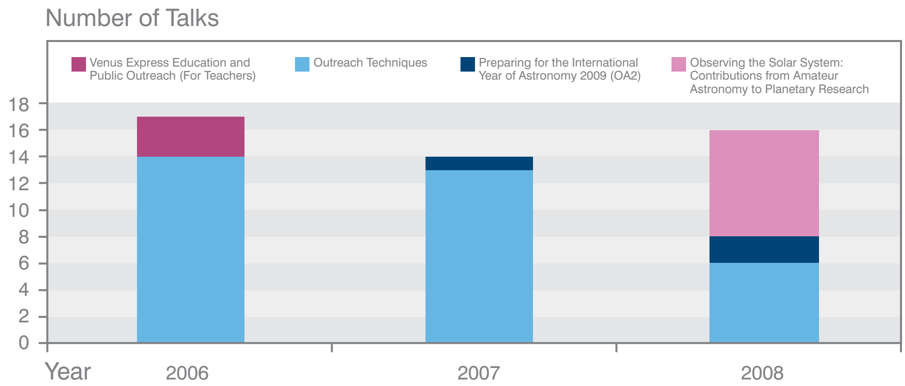


Figure 1 – Talks given at the ESPC for the period 2006-2008.

One of the motivations for organisers to make time for outreach sessions in what are usually very crowded conference timetables is that they can provide a good opportunity for scientists to come into contact with current outreach activities, with a view to encouraging them to do more in future. Although, this is not a new phenomenon, the true value for both the scientific community and other communicators has received little attention. So are these networking opportunities helping scientists and science communicators to work together better to share discoveries with the public? This article looks at the experiences of the EPSC outreach sessions.

European Planetary Science Congress outreach sessions

The annual EPSC covers a wide range of planetary and space science topics, including outreach sessions. The three five-day meetings held so far (Berlin 2006, Potsdam 2007 and Münster 2008) have proved that European planetary scientists do want to meet together on "home soil", with around 600 scientific abstracts submitted and an average of 500 participants every year. The EPSC programme is very much put together in a "bottom-up" manner. Each year a call goes out to members of the EuroPlaNet community for them to suggest topics on which they would like to see sessions, and — once the sessions have been decided — there is a subsequent call for scientists and groups of scientists to propose talks and posters. So the programme very much reflects what is on the minds of European planetary scientists during the previous six to nine months.

Studies based on a relatively young conference are clearly not very reliable. But adding up the number of sessions gives some idea of the importance that is being attached to various activities. Major themes in the 2008 EPSC, for example, included Saturn's moons, Titan and Enceladus, the Moon itself and Mars. Comparing year-on-year also indicates changing priorities; a hot topic in 2006 and 2007 was the magnetosphere of Saturn, as probed by Cassini and from the ground, but this area had cooled somewhat by 2008 (Figure 1).

The 2006 EPSC showed that participants were very keen to have outreach activities discussed. A whole day was scheduled for outreach sessions, and there were 26 accepted contributions for the main open session on Outreach Techniques (see Table 1). In the event, several of these presentations were either not given, as the speakers were unable to attend, or were "merged" by the session organisers because one speaker or group had offered a number of talks, and time simply did allow for all to be presented. Scientists involved with Venus Express organised a special session for local teachers, so that they could be presented with the latest findings from Earth's "evil twin" planet, and be given materials that they could use in the classroom. A final evening session turned into a discussion about a topic that had caught the public imagination across the globe — whether or not Pluto should have remained as the ninth full planet or should have been "demoted" to dwarf planet status.

In 2007, there were just two timetabled sessions, one on Outreach Techniques, as before, and one workshop on preparations for the 2009 International Year of Astronomy (IYA2009). The general session on techniques attracted 14 accepted contributions (see Table 1). These showed a somewhat more reflective nature, with phrases such as "the good, the bad and the ugly", "learning" and "challenges" showing that the contributors were not simply out to "wow" the audience with the latest tricks of the trade, but were also genuinely trying to pass on wisdom hard won from looking at what did not work, as well as what did (always a more pleasant job).

The EPSC outreach sessions have to compete with several more traditional science-focused sessions all running in parallel. At the 2008 meeting in Münster, the involvement of the local university, and the attraction of a European astronaut, brought several hundred local citizens to the congress venue for the evening public meeting held outside of the main congress schedule. This talk was given in German, unlike the rest of the congress, for which English was the only accepted language.

As with 2006, EPSC 2008 saw three outreach sessions (see Table 1). With IYA2009 so close, there were six accepted contributions under the heading "Preparation for IYA2009". Agencies such as ESA and NASA presented their plans and discussed potential co-operations during the IYA2009. An example is the interest manifested by ESA in contributing throughout its IYA2009 activities to the JPL's project "Cassini Scientist for a day program" — an essay competition primarily for students aged 5–11 in the United States, which has recently been adopted in Britain, with a version for UK students aged 11–18. ESA also shared that its IYA2009 resources are adaptable and easily translated into other languages. Examples are *The Lives of Galileo* (a cosmic comic book) and the *Eyes on the Skies* (DVD movie and book), which have been designed for the public at large.

In 2008, only three accepted contributions were listed in the general Public Outreach session. However, there was considerable interest in the session on the Contributions from Amateur Astronomy to Planetary Research. This session, with ten accepted contributions (again, not all were given), built on the growing interest and involvement of the amateur community with EuroPlaNet, a trend that the new network will build on in the years from 2009 onwards under FP7.

Participation in the EPSC outreach sessions

Until recently, science communicators were mostly not involved in scientific con-

Table 1. Outreach sessions at ESPC for the period 2006-2008.

2006 Sessions[5]

Outreach Techniques Session (OA1)

- UK goes to the Planets
- An outreach experience
- A Virtual Tour of the Universe
- Hands-on Universe – Europe
- A quantative and qualitative analysis of science communication in the Greek mass media
- Communicating about space science and exploration: a two way street
- Dedicated Space Science Education Centres Provide the Model for Effective Outreach
- Mission to the Public: A Journalist's Experiences with European Astronomers and Space Agencies
- Cassini-Huygens Communication -Think Globally, Act Locally
- Cassini-Huygens Outreach: It takes a village to reach the world
- 3D animations explaining the rotation, libration, and tides of planets
- Mars in their eyes – a cartoon exhibition
- The Planetary Society and EuroPlaNet Outreach
- Astronomy journalist views

Venus Express Education and Public Outreach (For Teachers) Session (OA2)

- Introduction on the Science objectives of the Venus Express mission
- Demonstration on how actual data from the mission can be used to teach your students required physical science concepts.
- The unsolved mysteries of Venus learning modules.

2007 Sessions[6]

Outreach Techniques Session (OA1)

- Planetary Science from the Teaching Department of Paris Observatory
- An outreach activity at the frontier of science: the Planeterrella
- New opportunities in public outreach
- Virtual presence for mission visualization: computer game technology provides a new approach
- Communicating Astronomy in Europe: Strategies and Challenges in International Organisations
- Cassini Education and Public Outreach: Lessons Learned – It Takes A Village to Reach the World
- The good, the bad and the ugly – learning good practice in science communication through experience
- European Hands-on Universe
- Public and schools learning about the Solar System
- Communicating Astronomy with the Public
- The Pluto Affair: The good, the bad or the ugly?
- Media perspective – new opportunities for reaching audiences
- Film and Science Education: the combination

Preparing for the International Year of Astronomy 2009 Session (OA2)

- Communicating Astronomy: IYA2009 planning of outreach activities

2008 Sessions[7]

Preparing for the International Year of Astronomy 2009 Session (OA1)

- Virtual space exploration: let's use web-based computer game technology to boost IYA 2009 public interest
- European participation in the JPL Cassini Scientist for a day program
- ESA's plans for IYA2009
- Copernicus Project for the International Year of Astronomy
- What's Up? Use the night sky to engage the public through amateur astronomy in IYA
- How to engage the Media in International Year of Astronomy

Public Outreach Session (OA2)

- Bootleg Postcards, the unofficial biography of Spirit and Opportunity
- Public's opinion on space exploration in Germany

Observing the Solar System: Contributions from Amateur Astronomy to Planetary Research Session (OA3)

- Making data from amateur astronomers scientifically useful
- Modern techniques of planetary imaging in use by amateurs and their application to the study of the atmospheric dynamics of Jupiter and Saturn
- JUPOS: amateur analysis of Jupiter images with specialized measurement software
- Seasonal Change on Titan's - HST, Cassini and Amateur Observations
- Stormy season on Saturn?
- Equinoxes on Jupiter and Saturn in 2009: call for observations
- Venus in Infra Red light - ground to ground with amateur equipment
- Measurement of stellar occultations

gresses themselves. Activities to foster public awareness, understanding, and engagement with science have been normally discussed in science communication congresses organised for that purpose, such as the international Public Communication of Science and Technology (PCST) biennial congress or the BAAS Science Communication conference.

The outreach sessions at EPSC, however, have proved to be a good place to generate fruitful discussions: outreach experts give presentations (~15 minutes each) followed by questions from participants. When asked, many of the participants said that they valued having focused discussions about communicating astronomy. Furthermore, they said they would participate in future as it is an excellent opportunity to be aware of what others are doing in the field. Moreover, participants appreciated that integrating the outreach sessions into a general scientific conference provided immediate contact for those involved with the latest achievements in the discipline and created stronger links within the planetary scientific community.

Average attendances at the daytime sessions, during the main congress itself, have been reasonable, but not spectacular — 30–40 — with participants from scientific institutions and space agencies such as ESA and NASA, artists, science journalists and amateur astronomers. The location of all three EPSCs in Germany is not an accident. This has been arranged so that eastern European countries such as Romania, Hungary, Ukraine and Russia could be well represented. Indeed, they have contributed to the outreach sessions. There has also been a good representation from the United States and Australia.

One issue of note is that, while outreach and media professionals have been well represented in these sessions, not many working scientists have been present. This is not completely surprising given that many other EPSC sessions occur at the same time, but it does show that the outreach sessions are not a priority for most of them. Clearly there is still a great deal to do to sensitise and encourage more scientist participants to attend the outreach sessions.

Conclusions

It is our aim here to reflect on the role the EuroPlaNet outreach session's initiative might play in reinforcing links between science and society.

The first is that the EuroPlaNet outreach sessions appear to have made a name for themselves. They have been successful in stimulating debate and discussions between professional communicators such as journalists, public information officers, astronomy amateurs, artists and the scientists themselves. We believe that they are a good opportunity for professionals working on the same scientific discipline to share resources and materials with one another and keep them in touch with the latest scientific achievements through contact with the broader scientific community.

Even though the number of attendees at the sessions has been more or less constant over the three-year period, they were mostly professionals of communication. The lower numbers of scientists present indicate that EuroPlaNet will have to work hard to deliver on its promises to engage the scientific community in future years. With the added emphasis on "users" — industry, politicians and ordinary citizens — envisaged under the EC's FP7 programme, such outreach sessions have the potential to develop public engagement in planetary science still further. In addition to being a forum for discussion, these sessions may also recruit and empower planetary scientists to play an active role in initiatives directed towards the communication of science.

Looking into the future

The EuroPlaNet project has changed from a purely networking activity to a research programme that will deliver results through the Joint-Research Activities/TransNational. EuroPlaNet will have a dedicated outreach/media team of three part-time workers, who will be proactive in bringing outreach opportunities to the attention of the planetary science community and the public. One of EuroPlaNet's planned outreach activities is to offer training in communication skills aimed at young researchers and PhD students. Giving them opportunities to develop their communication skills may encourage them to do more in future. Another strategy is the creation of a Media Centre aimed at strengthening relations between scientists and the media. This will work as a platform to seek out European sources of news in astronomy and space science, and to let the public know what Europe is doing in space and planetary sciences. We believe that these and other EuroPlaNet initiatives might help to forge relations between science and society and result in a more informed public supportive to space sciences and science in general.

Acknowledgments

We acknowledge the Portuguese Science and Technology Foundation (FCT) for funding Marta Entradas's research at UCL, UK. We also thank Norma Morris, Anita Heward and Jean-Pierre Lebreton for helpful discussions about this paper.

References

- Enserink, M. 2004, *Europe Clones U.S. Science Festival*, Science, 305, 1387
- Enserink, M. 2008, *Europe's Science Gathering Draws Crowds and Long-Term Funds*, Science, 321, 475
- European Commission 2001, *Science and Society Action Plan*, (Brussels: European Commission)
- European Commission 2001, *Europeans, Science and Technology*, Eurobarometer 2005, (Brussels: European Commission)
- European Commission 2007, *Public engagement in science – report of the Science and Society Session*, Portuguese Presidency Conference, The Future of Science and Technology in Europe, (Lisbon: European Commission)
- Finarelli, P. & Pryke, I. 2007, *Building and maintaining the constituency for long-term space exploration*, Space Policy, 23, 13
- Gregory, J. & Miller, S. 1998, *Science in Public: Communication, Culture and Credibility*, (New York: Plenum)
- Jergovic, B. & Miller, S. 2008, *Framing space: UK press coverage of the Beagle 2 and Cassini-Huygens space missions*, Communicating Astronomy with the Public journal, 3, 5
- Jones, H. et al. 2007, *A pilot survey of attitudes to space sciences and exploration among British school children*, Space Policy 23, 20.
- Lorenzen, D. 2005, *Europe in Space – taking off without the public?* in Communicating European Research, (Brussels: European Commission), 205
- Ottavianelli, G. & Good, M. 2002, *Space education: a step forward*, Space Policy, 18, 117
- Pearson, G. 2001, *The participation of scientists in the public understanding of science activities: the policy and practice of the U.K. Research Council*s, Public Understanding of Science, 10, 121
- Revuelta, G. 2005, *Training science communication in a swift moving society*, Communicating European Research 2005, European Commission, Brussels, Belgium, 109
- Royal Society of London 1985, *The Public Understanding of Science*, (London: Royal Society)
- The Framework for Coordination 2007, *The Global Exploration Strategy*
- BNSC 2008, *The UK Civil Strategy 2008-2012 and beyond*
- Brown, F. 2007, *Space Agencies and public outreach* – must try harder, Space Policy, 23:1
- Statement of Policy for the AAAS (Arden House Statement), http://archives.aaas.org/docs, 15 September 1951, 12 December 2008
- The ASTRONET Infrastructure Roadmap: A Strategic Plan for European Astronomy, 2008, http://www.astronet-eu.org/IMG/pdf/Astronet_Infrastructure_Roadmap.pdf

Notes

[1] Mars Express Mission's gallery available at: http://www.esa.int/SPECIALS/Mars_Express/index.html-Phoenix Mars Mission's gallery available at: http://phoenix.lpl.arizona.edu/

[2] http//www.esconet.org

[3] EuroPlaNet membership consists of scientists working in 60 European institutes and space agencies representing 17 European nationalities. More information can be found on: http://europlanet.cesr.fr or www.europlanet-eu.org.

[4] http//www.europlanet-eu.org

[5] http//www.cosis.net/members/meetings/programme/session_programme.php?m_id=34&p_id=229&day=1&view=session

[6] http//www.cosis.net/members/meetings/programme/session_programme.php?m_id=47&p_id=288&day=1&view=session

[7] http//www.cosis.net/members/meetings/sessions/oral_programme.php?p_id=348&s_id=6021

Biography

Marta Entradas is a PhD student in Science Communication in the Dept. of Science and Technology Studies at University College London, UK. She is interested in the relationship between science and society, science communication, and public engagement with science and technology. She is also a trainer on ESConet (European Science Communication Network).

Steve Miller is Head of Department of Science and Technology Studies at University College London, UK. He is also works as a planetary scientist at the Atmospheric Physics Laboratory in UCL's Physics and Astronomy Department. He chaired the Solar System Advisory Panel for PPARC (now the Science and Technology Facilities Council) between 2004 and 2007.

Where is Everyone?

Thomas Baekdal
www.baekdal.com
E-mail: thomas@baekdal.com

Key Words

Media
Communications
Social networking
Information

Summary

These days everyone is trying to connect with other people. It used to be simple, but in these technological times it is a little more complicated! We are currently in the midst of the most drastic change since the invention of the newspaper. In this article we are going to take a tour through the history of information, based on a year-long gathering of anecdotal evidence and we will try to answer some questions, e.g., how do we connect with other people today, and more importantly, how will we do it tomorrow?

Prologue

This study is not based on bulletproof quantitative data, guesswork or personal opinions, but on a combination of many things, including interviews, general studies, general trends and anecdotal evidence. The graphs covering the period before 1990 are all based on interviews and many Google searches to learn about the history of newspapers, TV and radio — and more specifically, which methods of information gathering people used in the past. The graphs covering the period from 1998 and up to today are based on all the things that have happened in the past 11 years, concerning which I have probably seen 1000 surveys. The graph for 2009 and forward is based on what I, and many other people, predict will happen in the years to come. The graphs are not intended to be 100% accurate, but rather to give an idea of the changing landscape, and to prepare for the future of social news, targeted information and the like. The purpose of the article is to push people forward. That said, I do believe they are reasonably accurate.

Introduction

We are seeing an entirely new way for people to interact; one that makes all traditional ways seem trivial. It is a fundamental shift

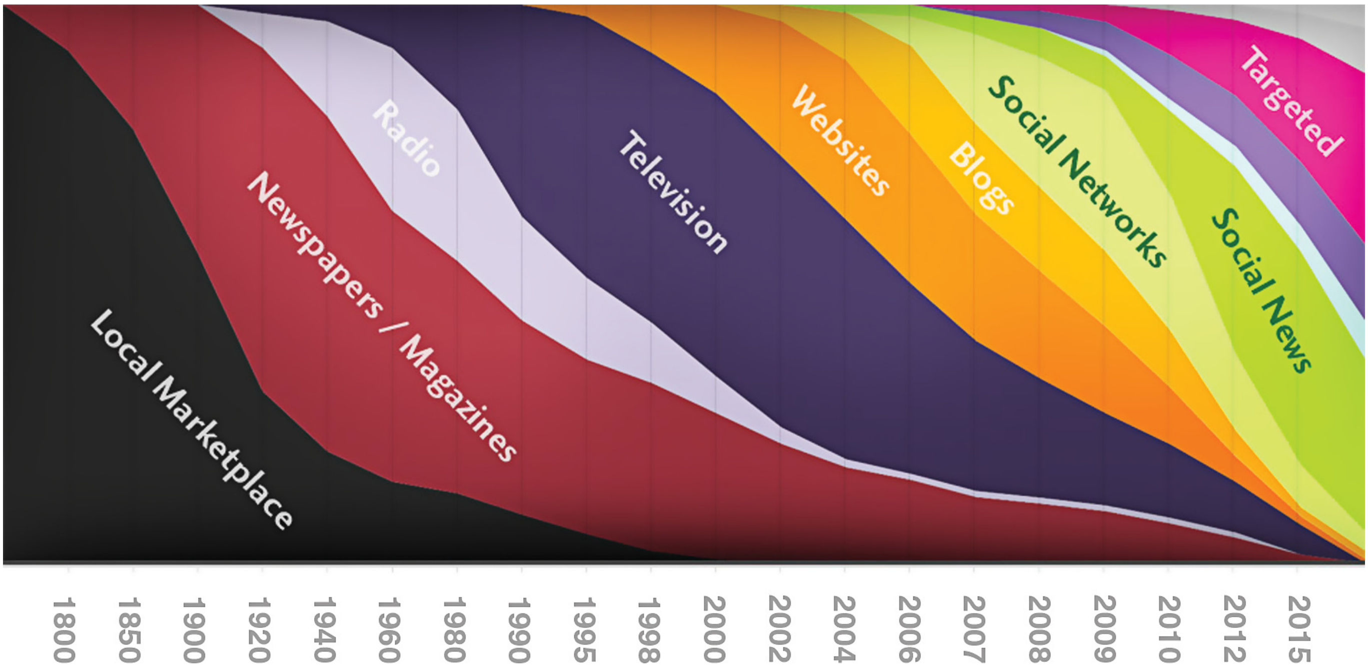


Figure 1. An overview of the changing trends in the media, 1800s to (predicted) 2020 and beyond. Note the non-linear time scale.

that will completely change the world as we know it. The best thing about it is that you will be able to help make it happen. So join me on this tour of the last 210 years of information sources plus a glimpse ten years ahead (Figure 1).

Before we start to explore the future, let's see how we reached the present. We'll begin by going back to 1800 — when finding out information was very different.

1800 — The face-to-face period

In the 1800s (Figure 2), the only way you could really interact with other people was to go out and meet them. It was all about face-to-face communication. To sell a product, you would go to the local marketplace and, in general, the only way to interact was to meet in person or to set up a stall. This meant for you to receive information — or to give it — you had to be at the right place at the right time. You wouldn't know what was happening in another part of the city, nor could you sell your products to people in other places. There was some talk of a novel concept called a newspaper...

By the year 1900 (Figure 3), newspapers and magazines had revolutionised how we communicated, allowing us to get news from places where we had never been. We could communicate our ideas to people we had never seen and sell our products to others far away.

You still had to go out to talk other people, but you could stay on top of things without leaving your own city. It was amazing; the first real information revolution. The world was opening up to everyone.

1900 — Read all about it!

From the 1920s on a new source of information caught people's attention — the radio. Suddenly you could listen to another person's voice hundreds of miles away. But most importantly, you could get the latest information live. It was another tremendous evolutionary step in the history of information. However, radio's development time meant that newspapers still dominated our lives in the years preceding the 1960s. If you wanted to get the latest news, or to tell people about your product, you would turn to the newspapers. It seemed as if they would surely be the dominant source of information for ever more.

1960 — We will be right back after these messages

This situation began to change in the 1960s (Figure 4). Radio had caught on, and the two dominant sources of information were live news from the radio and the more detailed news via newspapers and magazines. It was a great time for the media, although some said that "the way for newspapers to meet the competition of

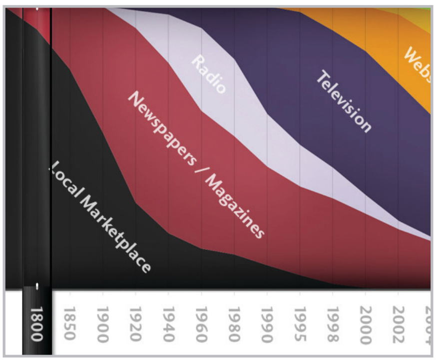


Figure 2. 1800, the age of local marketplace media.

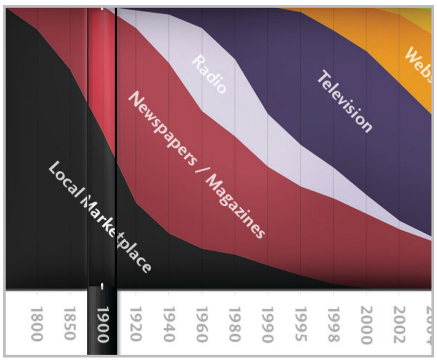


Figure 3. Newspapers gain popularity in the 1900s.

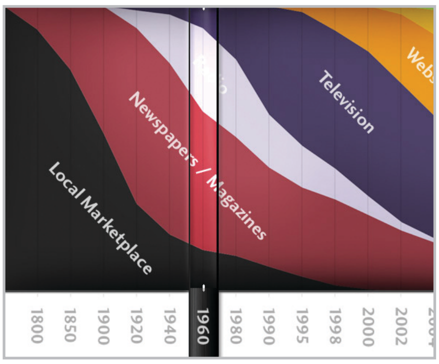


Figure 4. The emergence of radio in the 1960s.

radio is simply to produce better papers", an argument that we would hear repeatedly for the next 50 years.

1990 — Tune in to tomorrow

During the next 40 years the next technical revolution, television (Figure 5), was introduced. It began to gain public interest in the 1950s, and by the early 1990s its presence was huge, effectively surpassing newspapers and magazines whilst dominating the radio. Now people could both hear and see information.

The 1970s–1990s was also the time when newspaper executives realised that something was going terribly wrong with their market. They had had many problems in competing with radio, but television was in a different league again.

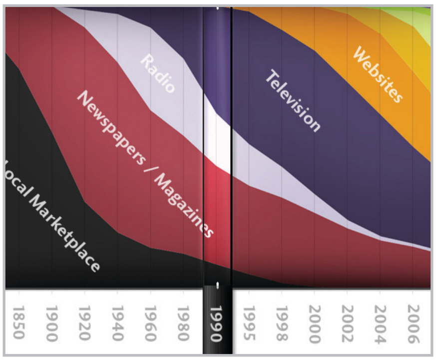


Figure 5. The 1990s, a popular time for television.

1998 — The dawn of the internet

Only eight years later and television ruled the information world (figure 6), radio had been almost reduced to "a place where you can listen to free music", and newspapers were doing everything they could to stay relevant. The constant evolution of technology ploughed ahead with never-before-seen determination. A new phenomenon loomed in the shadows: the internet.

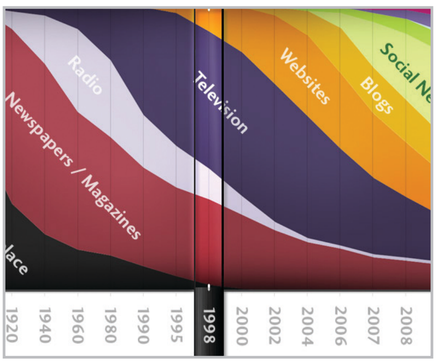


Figure 6. 1998, and the internet makes its presence felt.

1998 was the year when the internet changed from being a geeky place that had little relevance to being arguably essential, with an "every company needs to have a website" philosophy. The revolution had started three years earlier, but in 1998 it reached critical mass and caught everyone's attention, even if it was relatively little-used and most people did not have access to it. However, everyone agreed that it was the future; the dawn of a new era. It was a place where anyone could get information from anywhere — at least in theory.

People also started to realise that the internet was more than just information. You could give something back by joining the conversation and being a part of the experience instead of just a spectator. Most importantly, you could choose what you wanted to do and when you wanted to do it. The possibilities of the internet were mind-boggling.

2004 — I decide what to do!

In 2004, only six years later, and the internet had revolutionised how we approached information. Television and newspapers still dominated our news sources, but the new world was definitely online (Figure 7). People were making new websites and exploring the world of web applications. People could do such an incredible amount and participate in so many areas that a new concept appeared: information overload. For the first time in our lives we were being exposed to more information than we could consume. In the age of newspapers we had to choose what we wanted to see. In 2004 we had to choose what we didn't want to see.

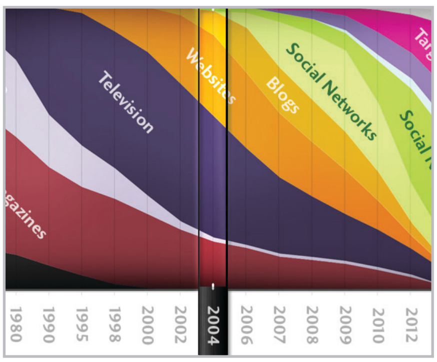


Figure 7. 2004, and the birth of social networking.

This had a devastating effect on the traditional forms of information. In the past you could get people's attention simply by making something. People wanted more choice, so you simply had to give them another option. In 2004 this changed, as it was not enough to make something different; it had to be better.

2004 was also year when another new phenomenon started to take off: social networking. The concept had been slowly gaining ground with the concept of blogs. They were an easy, simple and affordable way for everyone to share their ideas. For the first time, anyone could create their own sphere of information without doing anything "technical". Handling information changed from being a tool for the professionals to a tool for anyone.

2007 — Me too

Three years later and the social element of the internet showed just how powerful the voice of the people really is. For the first time television was no longer the primary source of information, and news-papers were struggling to survive. Everyone wanted to create their own little world, and connect it to their friends (Figure 8). 2007 was also the turning point for traditional websites, with people comparing them to newspapers — a static and passive form of information. We wanted active information. We wanted to be a part of it, not just to look at it.

Blogs started to get into trouble. Just as television had eliminated radio (because it was a better and richer way to give people live information), so were social networks eliminating blogs. A social profile is a more active way for people to share what they care about. Social networks are simply the best tool for the job, and blogs could not keep up.

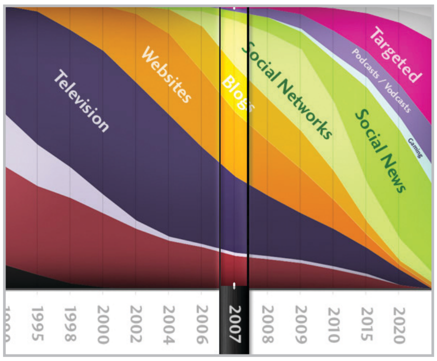


Figure 8. 2007, a turning point for new media.

2009 — Everything is social

Two years later, today, the new internet dominates our world completely (Figure 9). Newspapers are dead in the water, and people are watching less television than ever. We are the new kings of information, using social networking tools to connect and communicate. Even the traditional website is dying, killed by the relentless force of constant streaming information from social networks.

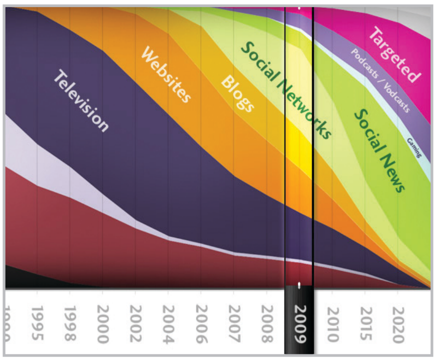


Figure 9. Social networks booming in 2009.

In the past 210 years we have seen an amazing evolution in how we obtain information. The principal forward steps are:

1. Getting information from distant places.
2. Getting it live.
3. Seeing it live.
4. Deciding when to see something, and what to see.
5. Being able to take part and comment.
6. Publishing our own information.
7. Being the source of information.

2009 will be the start of the next revolution. Everything we know is about to change.

The future

The first and most dramatic change is the concept of social news. This is quickly taking over our need to stay up to date with what goes on in the world. News is no longer being reported by journalists, as now it comes from anyone and everyone. It is being reported directly from the source to you — bypassing the traditional media channels.

Social news is much more than that. It is increasingly about getting news directly from the people who make it. Instead of having a journalist report what analysts are saying, you hear it from the analyst herself. Social news is getting news from the source, directly and unfiltered.

A new wave of entertainment is emerging (the light blue and purple areas on the graph), one dominated by the games, video and audio streams. Instead of tuning into a television channel, you decide what to see and when to see it. We no longer subscribe to channels where someone else decides what you can see. You control everything about the experience.

A new concept in the form of targeted information is slowly emerging. We are already seeing an increasing number of services on mobile phones that provide local information for the area that you are in. For example, instead of showing all the restaurants in the world, the phone will only show a list of those in your area. This is something that will explode in the years to come. In a world where we have access to more information that we can consume, getting the relevant information is going to be a very important element, expanding far beyond the simple geo-targeting that we see today.

2020 — Traditional is dead

Over the next five to ten years, the world of information will change (Figure 10). All the traditional forms will essentially die. Printed newspapers will no longer exist, television in the form of preset channels will be replaced by single shows that you can watch whenever you like. Radio shows are destined to be replaced with podcasts and vodcasts.

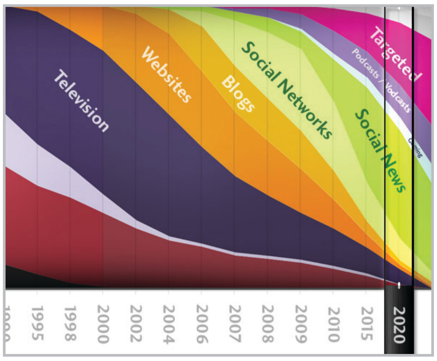


Figure 10. Predicting the future of the media communication methods.

Websites will have a much smaller role, as their primary function will be to serve as a hub for all the activities that you do elsewhere, becoming the place where people get the raw material for use in other places. Many websites and social networks will merge into one.

Social news, as described previously, is going to be the main way that people communicate. Traditional journalism will be completely superseded as people get information directly from the source. Everyone is a potential reporter, but new advances in targeting will eliminate most of the noise. Journalists will become editors who, instead of reporting the news, will bring it together to give us a bigger picture.

The news stream of the future will be personalised, and will constantly adjust what you see — much in the same way as Last.fm is doing today with music. Everything will incorporate some form of targeting. You will be in control over every single bit of information that flows your way.

In 2010, two new concepts will start to emerge. One of them is intelligent information, where information streams can combine pieces from many different news sources, not just by pulling data, but by summarising it, breaking it apart and extracting the valuable parts. Instead of reading five different articles on the same topic, you will be presented with one, highlighting the vital points of interest.

The world's information will also be available almost anywhere (Figure 11). The concept of going to get the paper, sitting in front of your television set, or looking at your computer, will be long gone. Information will not be something you have to get, but rather something that comes to you, wherever you are, in whatever situation you happen to be in. In the same way, information will not be something you "consume" at a certain time, as you did with prime-time television. The information stream will be a natural part of every second of your life. It is not something you fetch, it is something you have. The static and controlled forms of information that we see today will soon be a thing of the past.

Get ready!

Ask yourself: are you still trying to get journalists to write about your products? Are you still making websites? Is your social networking strategy to "get a Facebook page"? Or are you making yourself a natural part of people's stream of information?

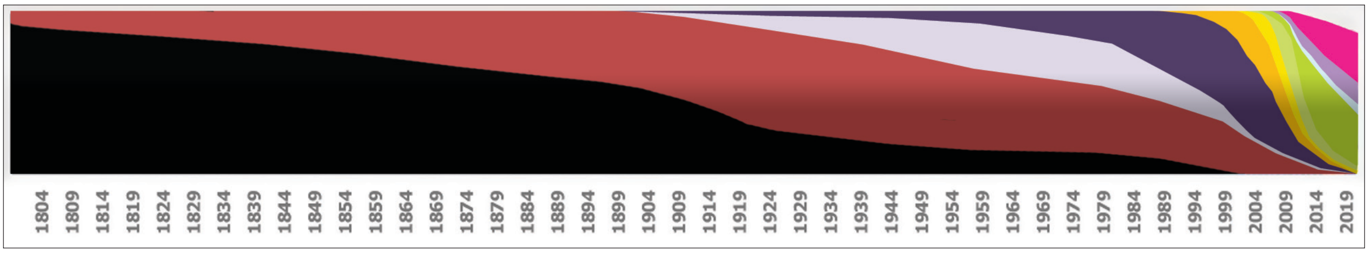


Figure 11. An overview of the changing trends in the media, 1800s to (predicted) 2020 and beyond using a linear scale.

Biography

Thomas Baekdal is a writer, social media advocate and owner of Baekdal.com, an online magazine that explores what it means to create a great experience. He works as a project manager and internet manager for one of Scandinavia's largest clothing companies. He also helps people and businesses to create a better internet strategy, and — on occasion — helps with implementation. As part of his job Thomas spends a lot of time working with internet trends and analysing why we react the way we do online. Many of his articles are the result of that work, or his speculations based on the trends that he sees every day.

Around the World in 80 Telescopes

Douglas Pierce-Price
ESO ePOD
E-mail: dpiercep@eso.org

Simon Lowery
ESO

Michaela Emundts
mindandvision

Andreas Wojtaschek
mindandvision

Mike Simmons
Astronomers without Borders

Lars Lindberg Christensen
ESO ePOD

Pedro Russo
IAU/ESO ePOD

on behalf of the Around the World in 80 Telescopes Production Team [1]

Key Words

Web Communication
Live Webcast
Broadcast

Summary

"Around the World in 80 Telescopes" was a record-breaking and unprecedented, live, 24-hour public webcast featuring most of the research-grade astronomical observatories both on and off the planet. It was part of the 100 Hours of Astronomy Global Cornerstone project of the International Year of Astronomy 2009. The goal of the webcast was to give members of the public a snapshot of life at research observatories around the world during a single 24-hour period, showing viewers the wide range of astronomers' activities at many, often very different, observatories. Here we give a full overview of the various components that went into the planning and implementation of this event, which was coordinated and executed by the ESO education and Public Outreach Department.

Introduction

The "Around the World in 80 Telescopes" webcast was coordinated from the European Southern Observatory (ESO) headquarters in Garching, near Munich, Germany. The 100 Hours of Astronomy event took place from 2–5 April 2009, and "Around the World in 80 Telescopes" itself ran from 09:00 UT on 3 April to 09:00 UT on 4 April.

The original concept was to visit all the observatories at close to local midnight, following the night around the planet. The final schedule was more flexible than this, partly because the "local midnight" concept was based on the idea of ground-based optical/infrared observatories, but also for practical reasons to do with filling the timetable properly.

History

The concept of a webcast from research observatories first came up in February 2006 in discussions between Lars Lindberg Christensen, Dennis Crabtree and Ian Robson from the International Astronomical Union's Commission 55 (Communicating Astronomy with the Public). Commission 55 had been asked to provide input for the implementation and content of a year of astronomy to the IAU Executive Committee. The concept was initially fairly ill-defined, including ideas like: "Showing the global network of observatories and the daily lives of astronomers... Live transmissions... Get the public in direct contact with the scientists."

In March 2006 this evolved into the concept of a 24-hour webcast with, now in hindsight, rather long, 2-hour segments (i.e. 12 observatories in total). This idea was supported by the Communicating Astronomy with the Public meeting in Athens in 2007, at which a 24-hour global star party was also suggested. Early in 2008 the webcast and the star party were combined by the IAU Executive Committee IYA2009 Working Group and the combined project grew in duration to approximately four days (the "100 hours") to allow public activities to occur during the week and at a weekend, and to reduce the risk of poor weather affecting the entire event. As a result, the research observatory webcast became a major 24-hour event embedded in the overall four-day series of events.

Fairly late in the process, in April 2008, the IYA2009 Working Group were looking for suitable chairs for the two components and appointed Douglas Pierce-Price from ESO for the webcast part and Mike Simmons from Astronomers without Borders (AWB) for the sidewalk astronomy part.

Table 1. The scheduled timetable for the webcast in Universal Time. Note that a small number of slots were moved in the live event, and there was an additional pre-recorded video contribution, from SOFIA.

UT Time	Observatory
09:00	Gemini North Telescope
09:20	Subaru Telescope
09:40	United Kingdom Infrared Telescope (UKIRT)
10:00	W. M. Keck Observatory
10:20	James Clerk Maxwell Telescope (JCMT)
10:40	Canada-France-Hawaii Telescope (CFHT)
11:00	Submillimeter Array
11:20	Caltech Submillimeter Observatory (CSO)
11:40	MOA Telescope
12:00	Anglo-Australian Telescope (AAT)
12:20	GEO600
12:40	Nobeyama Radio Observatory
13:00	Gunma Astronomical Observatory
13:20	Okayama Astrophysical Observatory (OAO)
13:40	Themis (Observatorio del Teide)
13:50	SolarLab (Observatorio del Teide)
14:00	Quijote (Observatorio del Teide)
14:10	ESA's XMM-Newton & INTEGRAL
14:40	Atacama Pathfinder Experiment (APEX)
15:00	Atacama Large Millimeter/submillimeter Array (ALMA)
15:20	European VLBI Network (EVN)
15:40	Westerbork Synthesis Radio Telescope (WSRT)
16:00	LOFAR, the LOW Frequency Array
16:20	Virgo Gravitational Wave Detector
16:40	Plateau de Bure Interferometer
17:00	Jodrell Bank Observatory
17:20	Hubble Space Telescope
17:40	Swift Gamma Ray Burst Explorer
18:00	Fermi Gamma-ray Space Telescope
18:20	The NRAO Very Large Array
18:40	Himalayan Chandra Telescope
19:00	NRAO Robert C. Byrd Green Bank Telescope
19:20	SOHO and TRACE
19:40	STEREO
20:00	LIGO Gravitational-Wave Observatory
20:20	Galaxy Evolution Explorer (GALEX)
20:40	Chandra X-ray Observatory
21:00	Southern African Large Telescope (SALT)
21:20	Spitzer Space Telescope
21:40	Observatoire de Haute-Provence
22:00	Calar Alto Observatory
22:20	IRAM 30-metre telescope
22:40	Hinode (SOLAR-B)
23:00	Gran Telescopio Canarias (La Palma)
23:10	William Herschel Telescope (La Palma)
23:20	Telescopio Nazionale Galileo (La Palma)
23:30	Swedish Solar Telescope (La Palma)
23:40	Allen Telescope Array
00:00	Telescope Bernard Lyot (TBL), Pic du Midi
00:20	Parkes Observatory
00:40	Space Sciences Laboratory - UC Berkeley
01:00	Hobart 26m (Mount Pleasant Observatory)
01:20	AIGO Gravitational Wave Observatory
01:40	Shanghai Radio Telescope
02:00	Arecibo Observatory
02:20	ESO Very Large Telescope (VLT)
02:40	Concordia station, Dome C, Antarctica
03:00	Las Campanas Observatory
03:20	ESO La Silla Observatory
03:40	Rothney Astrophysical Observatory
04:00	Gemini South telescope
04:20	Cerro Tololo Inter-American Observatory
04:40	Molonglo Observatory Synthesis Telescope
05:00	McDonald Observatory (Hobby-Eberly Telescope)
05:20	Apache Point Observatory
05:40	Large Binocular Telescope Observatory
06:00	TAMA 300
06:20	Arizona Radio Observatory SMT
06:35	Vatican Telescope, Mt Graham
06:50	MMT Observatory
07:05	Kepler Mission
07:25	South Pole Telescope and IceCube
07:40	Kitt Peak National Observatory
08:00	Lick Observatory
08:20	CHARA (Mount Wilson)
08:40	Palomar Observatory

Planning

It was decided at an early stage to have a strong role for the central coordinating site, with host presenters speaking to the remote observatories, rather than simply having each observatory take full control of the webcast for a certain time. This was done to give a unified style to the webcast, and to avoid speakers giving monologues to the audience.

For the live video connections to the observatories from Garching H.323 videoconferencing was the most appropriate choice. It provides a robust, professional solution, and many observatories already have dedicated hardware for video-conferencing that supports H.323 (for example, from the manufacturers Tandberg and Polycom).

Segment content

Rather than a few long webcast segments (as in the original concept of 12 two-hour timeslots), we decided that a larger number of shorter segments would make the pace of the event more exciting and allow us to feature more observatories. For example, 20-minute timeslots allow a total of 72 different observatories to participate.

For ground-based optical and infrared observatories, which we aimed to visit at close to local midnight, we would, in almost all cases, not be able to see the telescope itself. It would also not be possible to see the telescopes of space-based missions live, for obvious reasons. To give viewers the opportunity to see these facilities in a way not possible through a videoconference unit, and to avoid endless shots of control rooms, we asked observatories to provide a short pre-recorded video about their facility, lasting approximately five minutes.

As an additional "news" element, we also asked observatories to provide a previously unpublicised astronomical image, while understanding that not all facilities would be able to do so.

To make things simpler for the large number of separate webcast segments, we adopted — wherever possible — a standardised structure for each segment:

1. Introduction from the host in Garching.
2. Pre-recorded video from the observatory.
3. Presentation from the observatory speaker, in the form of a loosely scripted discussion with the host.
4. Presentation of a previously unpublicised astronomical image, where possible.
5. Further discussion and questions.

Contacting observatories and constructing the timetable

The main call for expressions of interest was distributed through the IYA2009 Single Points of Contact (SPoCs) mailing list and to a list of Public Information Officers at astronomical institutions. We also approached certain observatories directly, and solicited suggestions for specific observatories, either to fill gaps in the schedule at certain times or to expand the range of observatories represented (for example solar or neutrino observatories, or observatories in specific geographical regions such as Antarctica).

It became clear that a standard duration for each segment of 20 minutes (subject to change in certain cases) was the most appropriate for the number of observatories participating. The optical and infrared ground-based observatories were ordered by time zone, with the aim of scheduling them close to their local midnight. There are clusters of many observatories corresponding to certain longitudes (for example Hawaii and Chile), so some flexibility was required. In most cases, radio telescopes were scheduled during the day and space-based missions were scheduled during office hours at the facility from which they would join the webcast. Furthermore, some observatories had specific timeslot constraints, which we accommodated wherever possible.

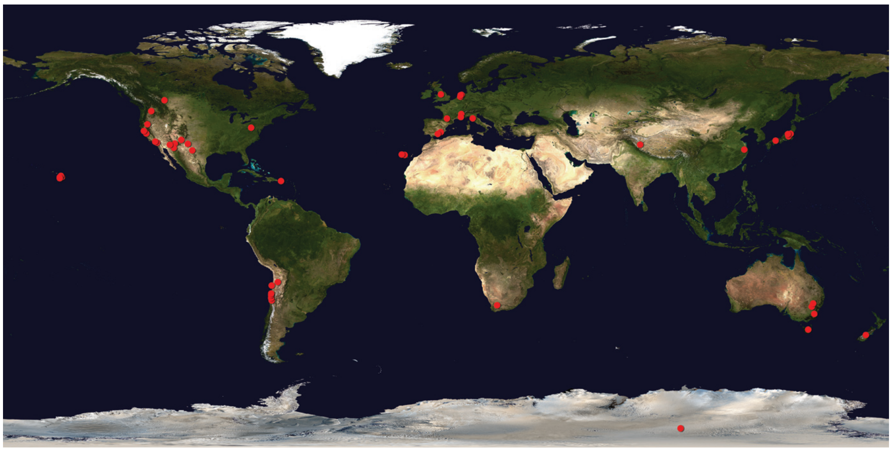


Figure 1: A map of the world, showing the global scope of the "Around the World in 80 Telescopes" 24-hour live webcast. The red dots show just some of the observatories (and ground locations for space-based telescopes) that participated in the event. "Around the World in 80 Telescopes" took viewers to every continent, including Antarctica! Credit: ESO/L. Calçada.

While we aimed to include many, if not all, of the "most advanced" observatories, no specific criterion such as telescope size was used. Neither was the duration of each segment weighted according to the perceived importance of the telescopes. It was also important to have a range of types of observatories and locations (we included observatories from all continents, including Antarctica).

After a lengthy scheduling process, the timetable no longer rigidly visited each observatory close to local midnight and it did not move uniformly westward around the planet. However, this had the advantage that a viewer watching an hour or two of the webcast would see a range of different kinds of telescopes in different locations.

Implementation

In the very early stages of planning, we considered doing all of the work to produce the webcast (videoconference links, overall video production, and web streaming) using in-house resources. However, it rapidly became clear that the technical aspects of the latter two components would be best handled by third parties.

Videoconference connections

As described above, we used standard H.323 protocol videoconferencing for the links between the remote observatories and ESO Garching. This provided a robust and high quality connection (where the underlying network connection was sufficiently good), ESO has significant in-house expertise in videoconferencing and most large observatories already use H.323-compliant systems.

A Tandberg 800 Media Processing System (MPS) multipoint control unit was used with multiple virtual "rooms" configured to provide the bridging capabilities needed, with participants being switched between rooms as necessary:

1. Dial-in room: this room provided a way for the few participants who could only dial in to ESO to dial directly to a given IP address. There was also an ISDN direct dial connection set up in this room.

2. Control conference room: each participant was placed in this room about 30 minutes before that observatory's segment, where they were greeted by the videoconference operator, using a Tandberg T1500 MXP unit in the "backstage" area, and given information before going live.

3. Live conference: participants were switched into this room for their live segments. Here a Tandberg 3000 MXP unit was connected directly to the video and audio mixers so that the observatory could interact with the host and be shown in the webcast.

In certain cases, several consecutive participants were needed, for example, from Teide or La Palma. To achieve this seamlessly, the multiple remote sites were connected in the live conference ("Room 3"), and all but the desired live participant had audio and video muted.

In most cases the bandwidth was set to 768 kbps, but in cases where this was not sustainable the bandwidth was reduced to accommodate the limited connection. The connection quality was tested by checking for packet loss and jitter while the remote site was connected to the control conference ("Room 2").

During the testing phase before the webcast, the main challenge was dealing with observatory firewalls, and required coordination between the network teams at ESO Garching and at the observatories.

The output from the Tandberg 3000 MXP (Room 3) was fed directly to the video production team's vision mixer and audio mixer, so that it could be seen and heard by the presenter and mixed into the webcast stream as needed.

If technical problems arose, the system we used could fall back on a basic (audio-only) telephone connection. We therefore requested that observatories send us a still image showing their chosen speaker on the telephone, to be used in such a situation. Fortunately it was not necessary to use this fallback option.

Public web pages

The public web pages about the webcast were hosted on the main 100 Hours of Astronomy website[2]. Here, we provided general information about the webcast, as well as a schedule for the event. Each observatory name in the schedule linked to a page of basic information about that observatory (description, photograph, Google Map showing location, and so on). All schedule times were given in Universal Time (UT), but with these times linking to pages[3] that presented these UT times converted into local times in major cities around the world. This was simpler than implementing a method for website visitors to view the schedule with local times in their own timezone.

Closer to the date of the webcast, the back-end of the schedule was converted into a database with a user interface for changing the times of segments, and whether a segment should appear in the "Schedule" section (with an associated time) or in the "Archive" section (with an associated link to a recorded video). The schedule was also converted to update asynchronously using AJAX, so that the webpage would automatically reflect any schedule changes, without the whole page having to be reloaded. This was required so that embedded video players would not have to be reloaded. Finally, a Google Maps world map overview, showing the observatory locations, was also implemented.

Video players for the webcast were implemented by embedding Flash video players for the stream from Ustream.tv. Observatories, media outlets, and anyone else interested were encouraged to embed the show on their own websites in the same way.

The Ustream.tv page for the 100 Hours of Astronomy stream was also customised, as far as was possible within the Ustream interface, to provide information about the event.

Video production

For the overall video production, we hired the German company *mindandvision*, who had also provided video production and webcasting for the German IYA2009 opening ceremony in Berlin. They were chosen in part because at this event they had demonstrated the ability to combine a videoconference connection (to ESO's Very Large Telescope on Paranal), a local host or presenter and an internet streaming provider well.

We selected a widescreen aspect ratio of 16:9 for the production, as opposed to the older aspect ratio of 4:3.

Pre-recorded videos

We requested that each participating observatory provide us with a pre-recorded video, or "trailer", approximately five minutes long, to give an overview of their observatory and show material that could not be shown during the videoconference link (such as animations, external shots, daytime views or helicopter footage). We provided a set of "ideal" and "acceptable" formats for this video, and then used the ESO in-house video team to convert all files into the single format requested by *mindandvision*.

As the webcast was global in scope, observatories were based in countries with differing video standards. In particular, while we worked internally with a framerate of 25 fps (frames per second), many observatories, particularly in the US, were in regions where the framerate standard is 30 fps. We therefore converted the footage framerate where necessary. In addition, not all observatories had 16:9 widescreen video available, so their footage was "pillarboxed" to fit the widescreen frame. Due to the large number of videos, we did not have time to make "tilt-and-scan" versions which would have filled the full 16:9 frame, and in some cases this was not possible anyway, because the 4:3 video contained material such as text captions or important graphics near the edges of the frame.

For another striking visual element, and to give a sense of geographical location on the planet during the webcast, we created a 15-second animation for each ground-based observatory in Google Earth Pro, with a zoom from space (showing the globe) down to the observatory site. These were played during the hosts' introductions to each segment.

Live video elements

Production of the live video elements was handled by the external company *mindandvision*. The local hosts were filmed against a bluescreen so that they could be displayed in a virtual set, with a virtual monitor in the background for displaying still images or video.

At the introduction of each segment the host was shown in the virtual set with a Google Earth zoom video on the virtual monitor where available. The host introduced the pre-recorded video for the observatory, before moving to the live videoconference connection. Three different shots were used during the videoconference: the host in a virtual set with remote speaker on the virtual monitor, remote speaker fullscreen, and host and remote speaker side-by-side in a "double box" layout. Switching between these shots, as well as display of on-air graphics and captions, was performed on the fly by *mindandvision*.

The hosts had a microphone and earpiece, and the producer could communicate with them through this. A teleprompter was used to provide guidelines for the hosts' speech, including default questions for the speakers from the observatories. These were intended only as guidelines, and the hosts were encouraged to ask different and/or additional questions, and to improvise an informal conversation. A laptop over the studio monitor, also visible to the host, was used for text messages such as questions from the audience.

Advance tests

Several weeks before the webcast, tests of the system (virtual studio, pre-recorded video, videoconference, host and remote speaker) were made using ESO's Very Large Telescope at Cerro Paranal as the remote site. This also provided a "preview video", which was made available on the webcast's Ustream.tv channel.

Filler material

During the advance tests, the typical segment lasted only about 15 minutes. We therefore suspected that we would need additional "filler" material during the 24-hour webcast. It was not possible to move the individual observatory segments closer together, as some were only available at certain UT ranges. Our plan was to use this filler material if we ran longer than about 5–10 minutes ahead of schedule, or if a technical problem meant we could not reach an observatory during the schedule. We planned to use individual chapters of the IAU's documentary *Eyes on the Skies*, and to repeat earlier segments of the webcast, if necessary. In the end only a very small part of this filler material was used.

Contingency plans

We constructed a detailed set of contingency plans for potential problems (technical problems with the videoconference connections, gaps in the schedule, and so on). These involved swapping observatories in the schedule, playing additional pre-recorded material, and falling back to an audio-only telephone connection with a still image of the speaker on the telephone.

Figure 2. Around the World in 80 Telescopes splash screen. Credit: ESO/L. Calçada.

Figure 3. Host presenters were filmed against a bluescreen (left), and composited into a virtual set with a virtual monitor which could display images or live — or recorded — video (right, upper). An alternative shot displayed the host presenter and the observatory speaker in a "double box" layout (right, lower). The videoconference feed or recorded video and images could also be displayed fullscreen. Credit: IAU/L. Pullen/ESO.

Host presenters

We identified six volunteer hosts, all of whom were ESO staff members. The hosts worked in pairs, swapping after every two observatories, for a total of eight hours each (divided into two shifts).

Web streaming video

Despite initial plans to generate the public webcast stream locally, it became clear that a better solution was to use an external provider. There are many such companies, and we investigated potential costs for the 24-hour live stream.

For a webcast of this duration, a major part of the streaming costs is the bandwidth required. Relevant quantities include the bitrate of each stream, the maximum number of simultaneous streams, and the total duration. Typical quotes that we received for up to 2500 simultaneous streams at a bitrate of 400 kbps were approximately €5000. These arrangements would have fairly hard limits in terms of the maximum number of simultaneous viewers. In other words, even if our average number of viewers was below the limit, viewers at peak times would not be able to connect if we already had too many viewers. It was considered that the uncertainty of the scale of the event made this option unacceptable, in case (for example) an astronomy club, science centre, or other group were unable to make a connection for a public event. We were also unable to commit to an unlimited bandwidth arrangement, as this would have left us open to unknown costs.

Partnership with Ustream.tv

While making enquiries about streaming providers, we were contacted by the team at Ustream.tv, one of the major live webcasting companies. Due to the unique nature and scale of "Around the World in 80 Telescopes", as well as its exciting content, they were keen to stream the show and help us publicise it.

The 100 Hours of Astronomy task group came to an agreement with Ustream whereby they became a global sponsor of the 100 Hours project, in exchange for support and publicity. We also webcast the 100 Hours opening ceremony and science centre webcast through the same Ustream channel.

As a contingency plan, we considered using a backup stream through an alternative provider (to be used in the event of problems with Ustream). However, when problems did occur during the live webcast, we decided not to switch as we felt that the Ustream links had already been very widely disseminated.

Advertising

Ustream's business model is to provide advertising-supported streaming free of charge to the public (both broadcasters and viewers). So advertisements were included, both on the 100 Hours page at Ustream.tv and as embedded overlays on the live video stream. The former advertisements were not visible to anyone viewing the video in an embedded player on another page, but the latter were visible to all viewers.

There were a noticeable number of complaints from viewers about the advertising, which was considered by some to be intrusive. The advertisements served were mostly not clearly targeted at the field of astronomy, and in one case (on the Ustream webpage) promoted a pseudoscientific account of an alleged Earth-impacting comet in 2012.

We knew that we would have to accept advertising on the video stream, and it was considered that this was a better option than paying for a capped stream, or the impossibility of committing to unknown and unlimited bandwidth costs, for the reasons given above. Nevertheless, for future events, an alternative, advertising-free solution is clearly desirable, if such a solution can be found.

Publicity and media relations

The "Around the World in 80 Telescopes" media strategy was defined in collaboration with the IYA2009 Secretariat and the IAU Press Officer. This strategy included two press releases for 100 Hours of Astronomy: the first one on 10 February 2009[4] and the second on 30 March 2009[5], as well as a webcast-specific ESO press release on 30 March 2009[6]. One week before the second IAU/IYA2009 press release, a draft press release text was made available for translation to all IYA2009 National Nodes and participating observatories. This enabled the local organisers and observatories to promote their related activities in their national and local media. Moreover, professional TV stations and broadcasters, as well as various high-traffic astronomy websites, were contacted and invited to feature the event and stream.

During the weeks preceding the event several updates were distributed to the IYA2009 network via the global website and e-mail. A Twitter feed (@telescopecast) was also used to engage with the public before and during the webcast.

Figure 4. Video and audio mixing, including the virtual set and virtual monitor, as well as on-air graphics and captions were handled on the fly by the production team in the backstage area. Credit: IAU/L. Pullen.

Audience interaction

In addition to our Twitter feed, we set up various incoming email addresses for the questions and comments from the public. Some of these were read out during the webcast, and others were answered in e-mail replies.

Staffing and resources

The main direct cost of the event was the contract for the video production. Although the price for other video productions may vary according to external factors such as travel, subsistence costs and which elements are done in-house and which by the company, the costs for this event, which included two people travelling to Munich for a day of early tests in March (three days including travel time), and four people for the webcast itself (arriving two days before the event), were a total of approximately €18 000. Catering costs and taxi costs for the event were approximately €1000, giving a total event cost of just under €20 000. This does not include manpower, which adds up to an estimated 0.8 FTE.

In addition to the project manager's role in advance of the event, other people played important roles. In particular, two interns did much of the liaison with and collection of information from the observatories; dealing with approximately 80 observatories was a significant effort. The web pages were constructed by ESO personnel, and an external contractor was responsible for the dynamically updated content, with a database backend.

The videoconference connections were arranged and tested in advance by IT personnel at ESO.

During the webcast, team members worked in the following roles:

- Producer/coordinator (1 person)
- Videoconference support (2 people)
- Video production (2–4 people)
- Autocue control (1 person)
- Online support (~2 people): updating web pages, Ustream recording console, Twitter feed, e-mails.
- Hosts (six hosts, working in pairs and alternating after every two observatories, worked in two shifts each for a total of eight hours).

In addition, we had logistical support, for matters such as catering, safety, the provision of air mattresses for sleeping and arranging transport for people who had to travel during the middle of the night.

Figure 5. Observatories were connected to a videoconference in the backstage area about 30 minutes before going live, where they were greeted and given information while the connection was tested. Credit: IAU/L. Pullen.

Figure 6. Host presenters saw the teleprompter in front of the camera (right), a monitor showing the live webcast output (left, lower), and a screen for additional text messages (left, upper). Credit: IAU/L. Pullen.

Running the live event

The video production team arrived in the afternoon of 1 April to set up their video equipment and the set, including the lighting and bluescreen. The day of 2 April was spent in setting up and testing, as well as rehearsals by some of the hosts to familiarise themselves with the equipment.

Against the bluescreen, the hosts sat on a tall stool at a (real) table. The autocue was used for "basic cues" rather than to provide a complete script to the hosts. In other words, only basic questions were provided and the hosts were encouraged to use these as guidelines but to improvise, add variation, and ask further questions. The production team could also speak with the hosts through an earpiece, messages to be read out from the audience were displayed on a laptop screen mounted above the hosts' monitor, and simple paper printouts were also used.

The webcast began at 11:00 CEST (09:00 UT) on 3 April. While running through the scheduled observatories, we also kept our Twitter feed updated, invited members of the public to send messages and questions to a dedicated e-mail address, and read some of these out live. Others were replied to by e-mail.

Although we had prepared supplementary recorded material to fill gaps in the schedule, this proved to be almost unnecessary. There were very few cases where we had technical problems with a videoconference connection that required us to reschedule observatories. The main such case was that of the Shanghai Radio Telescope. While we were unable to include it at its scheduled time, we moved it to the penultimate position in the timetable, as we were able to shift the last observatory slightly.

Technical problems

For a 24-hour continuous live event, the webcast went very smoothly, with some minor errors over the 24 hours, for example in captions and video mixing. There were two main areas where other problems occurred: with the live streaming itself, and at the 100 Hours of Astronomy website.

There were two significant periods when we had problems with the webcast stream. The first occurred near the beginning of the 24 hours, when viewers were unable to watch the live stream, but our video was reaching Ustream because the video was appearing in the "recorded clips" archive on the site. This was resolved after about an hour Approximately half way through the webcast, we had a problem when we were unable to broadcast to Ustream. In both cases, a telephone call to Ustream appeared to fix the problem. However, we were fortunate to be able to speak to someone at Ustream during their local night, as we did not have a designated 24-hour support number.

Figure 7. The teleprompter was controlled by an operator backstage, providing guidelines for the host presenters' speech. Credit: IAU/L. Pullen.

The main 100 Hours of Astronomy website[7] itself stopped working under extremely heavy load near the start of the "100 Hours" period. Therefore, during the webcast, we replaced our original content with static pages, and also made information available on the ESO website, which was under our direct control.

The 4am Project

As an interesting side result, at 04:00 local time during the webcast we took a photograph of the backstage team as a contribution to the 4am Project[8], which, coincidentally, was occurring during our event. The aim of the project was to encourage people to submit photographs taken at 4am (local time) on 4 April (4/4).

Metrics and results

Participating observatories

There were a total of 76 timetabled segments in the schedule, corresponding to over 80 telescopes (since some observatories had more than one telescope). In addition, we showed a pre-recorded video submitted by SOFIA when we had time available in the schedule. Different wavelength ranges were well represented, with radio, submillimetre, infrared, optical, ultraviolet, X-ray and gamma-ray telescopes. We also had neutrino and gravitational wave observatories. Ground-based, space-based and airborne observatories were represented. We featured telescopes on all seven continents, including Antarctica. Almost all "major observatories" were included, but we were, to a great degree, dependent on having observatories approach us directly (there was not time to chase individual observatories to participate).

This wide range of observatories gave us a wonderful sense of diversity in the segments, and in the presenters, as did the different things that some observatories did during their segments (roving tours, multiple cameras, presentation of models, rolling of additional video from the remote end, and so on).

Viewer numbers

Viewer metrics measured by Ustream are available for the webcast. We believe that these are underestimates, for two reasons:

1. We saw some periods during the webcast, especially during the second half, where the "viewer count" in the video player was simply not present, even though the live stream was running (i.e. no number was shown, not even zero) and we therefore suspect that not all the data were collected.
2. We know that there is a multiplication factor, as many places showed the webcast to a wider audience (e.g., in science centres and planetariums, at astronomy clubs, or on campuses).

It is therefore quite plausible to double these numbers, or perhaps even apply a slightly larger multiplication factor. The raw numbers from Ustream are:

Ustream report about 107 000 unique viewers, with about 156 000 viewers in total. In addition, hundreds of people were continuously in the Ustream chat box, and indeed there were still a few hundred in there talking about the webcast several hours after it finished.

Lessons learned

Some lessons learned for future such projects include:

- It was more difficult than anticipated to get timely information from many observatories, despite deadlines. Earlier, harder deadlines may help in the future, although there will always need to be some flexibility.
- Local contacts at each observatory location are vital (national-level contacts can be helpful, but local contacts are needed to make the arrangements).
- With nominally 20-minute segments, there was essentially no empty time in the timetable (given the necessary breaks for switching observatories). The observatories had plenty to say, and the rapid schedule kept the event interesting.
- An improved, advertising-free web video streaming solution is desirable. The streaming problems, and the advertising, were the factors that created the most dissatisfaction among viewers. However, this may involve paying for the streaming. A direct technical contact number should be available and tested in advance.
- A standard computer running the stream in a browser is important so that a view of what the public see is also available.
- It was very helpful to standardise the segments as much as possible.
- Minor changes or problems are potentially multiplied by ~80. Coordinating so many observatories is challenging, but it is possible.
- With more time, it would be desirable to investigate rebroadcasting the stream through television channels, for example through the European Broadcasting Union.

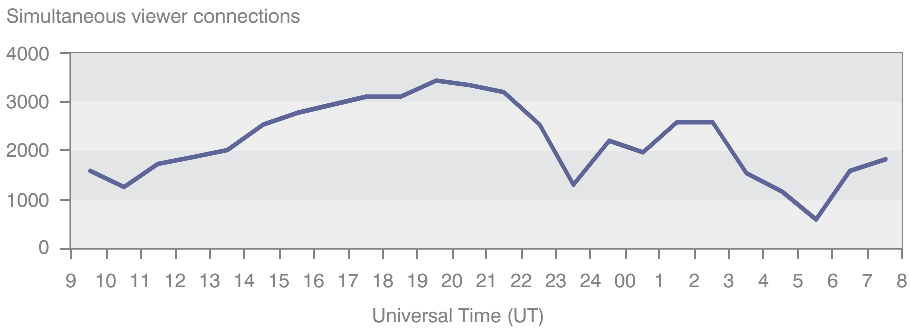


Figure 8. Number of simultaneous viewer connections recorded over the course of the webcast. Times are in Universal Time (UT) from 2009-04-03 09:00 UT to 2009-04-04 09:00 UT. Numbers were recorded by hand from the Ustream player display up to three times per hour, and the average is shown for each one-hour period. No values were recorded during the period 16:00–17:00 UT. The peak number of simultaneous viewers recorded was about 3600. We believe these figures are underestimates, for various reasons, as discussed in the text.

Astronomical images and observatory videos

While not every observatory was able to provide a previously unpublicised astronomical image, we did receive images from 47 of the participants. We also broadcast a total of 67 different pre-recorded videos from the observatories. In many cases, these videos were created for the webcast (sometimes by observatories who had not made video material before), but they are of course now also available for future outreach.

Web traffic

During the period 1–6 April (the "100 Hours" plus one day either side) the 100 Hours of Astronomy website served 2.6 million pages, with 230 000 visits from 170 000 unique sites. However, it also suffered under an extremely heavy load, meaning that we had to replace pages with basic, static content. It is therefore difficult to draw detailed conclusions from the web statistics, but there was clearly extremely strong interest in the site.

- Having "Around the World in 80 Telescopes" embedded in the 100 Hours of Astronomy project, which also included sidewalk astronomy events and more, was helpful in terms of coordinating publicity and public participation. However, the implementation of the webcast could be kept mostly independent of the other projects, and this would simplify the organisation.

Figure 9. It's 4am on 4/4/2009 at the ESO headquarters in Munich, and the team is 17 hours into the live 24-hour webcast marathon of "Around the World in 80 Telescopes". This photograph was taken as part of the 4am Project. Credit: IAU/L. Pullen.

Feedback

Feedback, both from participating observatories and from viewers (by email and Twitter), is extremely positive. Example comments include:

Thank you so much! It has been an amazing event!

Wonderful, interesting and informative coverage.

This 100 webcast is wonderful, beautiful, inspiring and hugely Interesting!!! Thank you for bringing this to us. It is very well done and I'm greatly enjoying it.

I just wanted to congratulate you all on this amazing project. I've thoroughly enjoyed gaining an insight into the extraordinary people and their work across this planet of ours.

I started watching at the beginning from Gemini North and could hardly tear myself away. I managed to watch most of the amazing 24 hours, finishing off at Palomar. What an amazing ride. Thank you all for a truly groundbreaking programme!

This programme is excellent. Thanks so much for doing this! It is great seeing what these observatories are accomplishing.

I'm very impressed by your presentations, and the production quality is better than most television broadcasts!

Just wanted to say that this broadcast has been the best thing I've ever seen on the internet and one of the most interesting things I've seen in my life. Thanks for the amazing, brilliant, superb work and hope to see all the sections on a DVD or something in future. I'd sure like to watch them over and over again.

**applause* *applause* *applause* *applause* Best web tv I've seen.*

Further tangible outcomes

As a result of "Around the World in 80 Telescopes", we have 24 hours of archived video footage, which is available for online viewing and download[9] (without advertising, as the archive is not only at Ustream). This includes many hours, in total, of outreach videos from the observatories, which can be used independently of the webcast. We are also discussing the possible use of the webcast material in, for example, television programmes. ESO has released an episode of its ESOcast video podcast which shows the making of the webcast[10].

There has been significant interest in a DVD containing highlights of the 24 hours, and this is a project that we are actively considering. However, it will involve a further investment of time, effort and funds, as the archive will need to be edited down to fit onto a single DVD. A final decision on whether to do this has not yet been made.

In addition to the video material, the observatories produced almost fifty previously unpublicised astronomical images, which will also play roles in future outreach activities.

We have developed expertise in running events of this kind, and will discuss the project in talks, beginning with a talk given at the European Week of Astronomy and Space Science (Joint European and National Astronomy Meeting) 2009.

Legacy and conclusions

"Around the World in 80 Telescopes" was the first time that so many research observatories were linked for an outreach activity (and possibly for any joint activity). The webcast was exciting for both participants and viewers, and the wide range of observatories gave a striking demonstration of the global diversity of astronomy.

Taking part in the webcast galvanised, or encouraged, observatories to engage in outreach during the International Year of Astronomy, often in new ways, for example with the creation of outreach videos about their observatories. Not only will the material created be useful in the future for these observatories, but these newly developed skills will play an important role in further outreach activities. We are extremely grateful to all the observatories that participated for their hard work and enthusiasm, and will be distributing certificates of thanks.

We used cutting-edge technology to put the programme together, and despite some technical challenges during the webcast, none of the timetabled observatories were missed out.

"Around the World in 80 Telescopes" was an ambitious, unprecedented and historic event. It was a great success, and we are grateful to the observatories, and the many viewers, who took part in this global astronomical journey!

Notes

1 In addition to the listed authors, the webcast production team also included: Catherine Moloney, Karin Ranero, Raquel Shida, Mariana Barrosa, Luis Calçada, Martin Kornmesser, Herbert Zodet, Olivier Hainaut, Gaitee Hussain, Markus Kissler-Patig, Joe Liske, Nadine Neumayer, Colleen Sharkey, Berkan Maruthadiyan, Stefan Grohmann, Lee Pullen, Thomas Simon, Gabriele Zech and Britt Sjoeberg.

2 http//www.100hoursofastronomy.org

3 http//www.timeanddate.com

4 http//www.astronomy2009.org/news/pressreleases/detail/iya0904/

5 http//www.astronomy2009.org/news/pressreleases/detail/iya0908/

6 http//www.eso.org/public/outreach/press-rel/pr-2009/pr-13-09.html

7 http//www.100hoursofastronomy.org/

8 http//www.4amproject.org/

9 http//www.eso.org/public/events/special-evt/100ha/

10 http// www.eso.org/gallery/v/Videos/esocast/ESOCAST7_P_FLASH.flv.html

Live Casting: Bringing Astronomy to the Masses in Real Time

Pamela L. Gay
SIUE/Astronomy Cast
E-mail: pamela@starstryder.com

Phil Plait
Bad Astronomy/Discover Magazine
E-mail: thebadastronomer@gmail.com

Jordan Raddick
Johns Hopkins University
E-mail: raddick@pha.jhu.edu

Fraser Cain
Universe Today/Astronomy Cast
E-mail: info@universetoday.com

Emily Lakdawalla
Planetary Society
E-mail: emily.lakdawalla@planetary.org

Key Words

Live Webcast
Web 2.0
New Media

Summary

The way we receive information in today's digital society has radically changed. Audiences are no longer passive consumers of content, but expect to be able to access the latest news rapidly from a variety of portals and sources. The needs of this rapidly expanding tech-savvy community are being met by a community of bloggers, podcasters and vodcasters, who use a suite of textual, audio and video content to reach their audience, many of whom subscribe to and follow content they enjoy. These communicators are the new faces of public outreach and journalism, and they are most effective when closest to the action. This desire to bring online audiences into the conference room alongside the scientists and professionals had led to the development of live-blogging. The idea is simple; anyone sitting somewhere interesting only needs a connection to the internet to report their experiences in real time.

Introduction

In the internet age, the time between when news is made and when it is consumed has shortened dramatically. In the past it might have taken several months for announcements from scientists to transform from press releases into magazine articles sitting on a newsstand. Science coverage in newspapers shortens this period to a few days. The spread of high speed internet connections has collapsed this period to just a few hours, with many stories receiving wide coverage within minutes of release.

In 2005 a new trend began to emerge for the media coverage of events that unfold over days or weeks: live blogging. Instead of waiting until after a press conference is complete, journalists are publicising events in real time, "blogging" the details to an audience through the internet.

During today's press conferences, journalists and bloggers with internet-connected laptops take live blogging to a new level, and not only type away as researchers speak, making the discoveries known immediately to a worldwide audience, but they also stream audio and video to an international audience, allowing questions from the global astronomy community to be asked in the moment. Using portable technologies, it is possible to transmit pictures, text, and even live audio and video streams out to an enthusiastic audience in real time. This technology also extends beyond the press conference, and allows scientists and journalists to convey the results presented in conference oral and poster sessions. It is even possible to conduct and stream interviews and conference sessions, thereby allowing the public to participate in a part of the scientific process that is generally kept behind closed doors.

In this paper we describe the technology and infrastructure that are required to make live webcasting a reality, strategies for creating content the public will want to consume, and describe the impact of our work.

Technology

Live webcasting is an overarching term that describes a suite of internet communications pipelines that allow bloggers, podcasters and videocasters to convey content to the public in real and near-real time. This suite includes: text-based (live blogged) content including Twittering, audio content, and video content. In the following subsections we discuss each of these technologies in turn. In addition to what is listed below, we also recommend carrying a digital camera.

Live blogging

The idea of live blogging is simple: an individual with a computer or other internet-enabled device sits at a live presentation and makes frequent updates to a website, allowing people to know what is happening in real or near-real time. Since 2005, the number of science bloggers has slowly increased, as has the diversity of ways meetings are conveyed. Today, live blogging comes in two basic flavours, full blog and micro blog (e.g., Twitter) coverage.

At their most basic level, blogs are RSS feeds that contain at least text. RSS, which stands for Really Simple Syndication, is a type of feed that uses the eXtensible Markup Language (XML) to transmit content in a set format understandable by web pages and aggregation software (see Gay et al., 2006, for examples and a complete description). These RSS feeds typically appear on a website that updates when the RSS is updated with a new story. Any RSS feed can also be subscribed to via aggregation software. Creating such a blog has been made easier by the advent of easily available software and hosting; the most prevalent blog software packages today are MovableType/TypePad (Trott, 2008) and Wordpress (Boren et al., 2008), while hosting companies such as Wordpress.com and Blogger.com are frequently used by the public and scientists alike.

There are just three elements needed to live blog using an existing standard blog: a person capable of listening and writing simultaneously, an internet-enabled device capable of communicating to the blog website and an internet connection. We recommend using a laptop computer with both a wireless card and a cellular internet card available. The procedure is simple: an individual sits in a session and translates to a public audience what is being said while an event is taking place, pushing their content to their blog in frequent bursts, often at the end of every five-minute talk or after writing each paragraph during longer sessions.

One of the greatest hurdles to overcome in live blogging is simply getting online. Many event facilities do not provide internet access in all the rooms. Many conference buildings also do not have a good cell phone signal throughout the facility. We strongly recommend working with conference organisers when possible to facilitate online access. Should internet access not be available in sessions, it may be necessary to blog in a text window, and then find a point where cellular internet access is available to upload stories between events.

The second largest hurdle to overcome is simple mental overload. Science sessions often last more than an hour and can include eight or more talks in that short period of time. Trying to constantly translate presented science content to a public audience is an exhausting process.

Figure 1. Gay recording an audio interview with Ralph Harvey (left) at LPSC. Credit: Astronomy Cast.

To cover meetings effectively, we recommend having two bloggers per day's worth of sessions you wish to cover. This means that if you want to fully blog a meeting with four parallel sessions running at all times, eight bloggers are needed. In general, it is rare at smaller meetings for there to be more than one newsworthy event at a given moment, and two bloggers are sufficient.

The second text-based mechanism for live blogging a meeting is to use Twitter (2008) or a similar micro-blogging technology. Twitter is a free web-based micro-blog service that allows users to "tweet" 140 characters at a time to anyone who subscribes to their RSS-based Twitter feed. Several NASA missions, including both Phoenix[1] and the Lunar Reconnaissance Orbiter[2], use this service to communicate updates on their programmes. NASA Education and Public Outreach specialist Stephanie Stockman frequently Twitters the content of science conferences under the username Geosteph. Twitter does not require an internet connection: it is possible to tweet via SMS text messaging from any standard cell phone. While being confined to 140 characters makes it difficult to translate complex science terms to the public, it is possible to share announcements that include web links easily from anywhere.

Audio- or podcasting

In addition to text-based coverage, audio interviews are also a part of the live webcasting suite. While most often carried out as a series of interviews that are then pushed to the public a few hours (or a day) after recording, it is also possible to stream content via software such as Ustream.tv (discussed in detail in the section Videocasting). In this section we focus on ways to facilitate audio recording for asynchronous transmission.

For live webcasting, the most important characteristics in an audio recorder are recording quality, long battery life and small size. Both Astronomy Cast and the BBC's *The Naked Scientists* use a Roland Edirol R-09 WAVE/mp3 handheld audio recorder and (as needed) an external wired microphone. This device easily fits into most pockets, uses standard AA batteries (which conveniently also fit into pockets), and can hold several hours of audio on a standard SD memory card.

Once audio has been recorded, it typically needs to be processed for online posting, and it may require editing. The most common issues with raw audio are uneven audio levels and background noise. Producers typically employ a combination of

GigaVox's Levelator (Sharpe et al., 2008) to level audio, and one of the following to filter and edit audio: Audacity (2008), Creative Suites 3 (Adobe, 2008) or iLife (Apple, 2008).

The necessity of processing content can be one of the greatest hurdles to overcome in both audio- and videocasting. This process takes time and often requires full concentration. We have identified three different strategies for dealing with production issues for both. The most straightforward solution is to bring along a production engineer, such as a mass communications student, to the conference or event and set them up to do nothing but production. A second solution is to upload all content to an offsite production team. This solution is more time-consuming because it requires all raw content — which typically means large files of hundreds of megabytes in size — to be transmitted over the internet before production can even begin. The third solution is the least effective, but cheapest, and it is to simply use all breaks, lunch and evening time for production. This solution is too exhausting for long conferences. A fourth compromise solution is also possible: to have a two-person live blogging team take turns as production assistant and content creator, so that one person is blogging/recording/interviewing while the other person is doing audio and video editing and production.

Figure 2. Miller attends STS-124 launch. Credit: Astronomy Cast.

We strongly recommend taking a student production assistant with their own dedicated production laptop to live webcast events and concentrating the student's efforts on content editing and acquisition of "B reel" footage and photographs to use in the background. From experience, we find that for the most minimal production (adding intro and outro audio, evening audio levels, processing to correct bit rates, and posting content), each 30 minutes of audio requires at least one hour of production.

Videocasting

With the price of video cameras dropping daily, even while increasing in capability, it has become possible to obtain video easily to either live stream or post to the internet in a variety of formats. The most commonly used options in the United States are posting content via YouTube/GoogleVideo, or streaming it live via the website Ustream.tv. Both YouTube/Google Video and Ustream.tv allow content to be embedded in any website. This means that content posted for free via these sites can be seen on any blog once it has been posted and the correct links are embedded on the target webpage.

Non-streamed, or static content, such as YouTube/Google Videos are typically recorded in 640 x 480 resolution or higher with MPEG4 encoding. Audio is typically 64 kpbs mono or 128 kbps stereo. While this can be recorded using many handheld digital cameras designed for filming stills, we recommend obtaining a digital video camera with firewire capabilities and a tripod. This type of a camera is more versatile and typically has much better audio quality. Common video production software includes iLife and Adobe Creative Suite 3. Additionally, a high-end laptop with at least 4GB of memory is recommended. We find that minimal production and uploading of five minutes of video takes a minimum of 20 minutes.

In addition to posting static content, it is also possible (and sometimes easier) to stream live content using the same Firewire camera. The popular website Ustream.tv facilitates streaming of video content. This site utilises the Adobe Flash Media server and Media Player to create on-demand video channels and corresponding chat rooms. Ustream.tv takes input from USB webcams and Firewire video cameras and audio from either those sources or another source (such as built in microphones or a Bluetooth headset). A high-end laptop is not necessary, and from experience we know that a 1.7 GHz G4 PowerMac with 512 Mb of memory is sufficient.

Streamed content is sent over the internet to Ustream.tv, and is then distributed to viewers. These viewers can interact with one another and potentially with the presenter via a live text-based chat room that can be moderated. To use Ustream.tv, it is necessary to have strong wireless signal or a physical connection to the Ethernet. Do not try and stream video content without collaborating with conference organisers as the bandwidth demands may be detrimental to other users.

One way people are solving potential camera-driver issues with Ustream.tv is to use the add-on software package CamTwist (Allocinit, 2008). CamTwist serves two purposes: it often provides (but not always) a more stable connection between a video camera and Ustream.tv, and it also allows one to switch between cameras, use special effects, and stream images and the content provider's computer's desktop. This means that one can, in principle, switch between projecting a speaker at the podium, and a still image from the streamer's hard drive. CamTwist is Mac-only; Webcammax is a similar piece of software for the PC that is compatible with Ustream.tv.

Implementation

In this section we detail the practical implementation of live webcasting both from standard science conferences and from space exploration related events, such as mission launches and mission events (e.g., a mission's arrival at another planet).

In all instances, prior to attending the conference or event, first work with the press liaison to make sure the necessary internet access and power access will be available. It is also wise to make sure there is an interview room available as part of the press suite. Once plans are made, post announcements on the project website and all affiliated websites.

When packing to attend a live webcasting event, we recommend bringing all the following equipment in quantities appropriate to the team size:

- laptop computer (we used MacBook Pros with 4GB RAM);
- digital still camera with flash;
- audio recorder (we used an EDIROL R-09);
- video camera (we used a Canon ZR100 with extended 5-hour battery);
- extension cables;
- tripod;
- jump drive, for getting images and presentation files from presenters;
- optional: extra laptop battery.

We actually found it was best to have a spare computer. This can be dedicated to streaming video while other computers are used to blog or perform other live webcasting activities.

Once technological infrastructure needs have been met, it is time to identify a live webcasting team, taking advantage of known bloggers where possible. The ideal team consists of one or more lead live webcasters, a network of affiliated bloggers who will already be attending the meeting and who will cross-post their content to the live webcast feed, a dedicated journalist who will transform press releases into stories (this can be a remote person), and a dedicated producer (this can be a remote person, but that is not recommended). Each team member covers a set of specific needs.

In selecting content to be covered, there are three general categories that should be covered to keep an interested audience: the science releases most likely to change our view of science; stories that have human interest; and niche stories that match the interests and passions of the content provider, presented with a personal spin that evokes a response from the audience.

Figure 3. Standard kit includes (counter clockwise from left) digital camera, video camera, wireless card, audio recorder, computer. Credit: Astronomy Cast.

Summary

In today's press-room, live webcasting is replacing traditional journalism as the first step in communicating astronomical results to the public. Through new media, large global audiences numbering in the tens or even hundreds of thousands can be easily reached. A single live webcaster at a science meeting in St. Louis can as easily reach a user in Africa as one in Chicago; the internet may have barriers, but it has no boundaries.

Live webcasting allows, as no other technique can, our audience to feel more as if they are participating in discovery; streamed video of press conferences brings several hundred extra people into the room, allowing them to share the moment news was broken.

This ability does not come without a cost and we have described above the investment in technology and people that is required. With solid planning, and support from conference organisers together with realistic expectations of what can be achieved by each team member, the technique is effective.

Acknowledgements

We would like to thank Chris Lintott for his comments on this paper, and to thank him, as well as other live webcast team members, Rebecca Bemrose-Fetter, Georgia Bracey, Lance Gibson, Scott Miller and Lance Walters, for their help making live webcasting a reality. This project was funded through NSF grant #0744944 with additional funding supplied through the generous donations of the Astronomy Cast audience.

References

- Adobe 2008, Adobe Creative Suite 3 Production Premium, http://www.adobe.com/products/creativesuite/production/?xNav=PP
- Allocinit 2008, CamTwist, http://allocinit.com/index.php?title=CamTwist
- Apple 2008, The New iLife, http://www.apple.com/ilife/
- Audacity 2008, About Audacity, http://audacity.sourceforge.net/about/
- Block, R. 2005, Gizmondo launches in North America, http://www.engadget.com/2005/10/22/gizmondo-launches-in-north-america/
- Boren, R. et al. 2008, About Wordpress, http://wordpress.org/about/
- Fischer, D. 2008, Private communication
- Gay, Price, Searle 2006
- Miller, S. 2008, STS-123 - A Space Geek's Pilgrimage: Part IV - Launch! http://www.astronomycast.com/LIVE/scottmiller/sts-123/sts-123-a-space-geek%e2%80%99s-pilgrimage-part-iv-launch/
- Sharpe, B. et al. 2008, The Levelator, http://www.conversationsnetwork.org/levelator
- Trott, M. 2008, Our History, http://www.sixapart.com/about/our-history/
- Twitter 2008, About Us, http://twitter.com/help/press

Notes

[1] http://twitter.com/MarsPhoenix

[2] http://twitter.com/LRO_NASA

Biography

Pamela L. Gay is an assistant research professor at Southern Illinois University Edwardsville. Her research interests include variable stars and assessing the impact of new media astronomy content on informal audiences. When not in the classroom or doing research, she co-hosts Astronomy Cast and writes the blog StarStryder.com.

Fraser Cain is the publisher of Universe Today, a space and astronomy news website. He's also a freelance writer, with several published books, and articles in periodicals such as Wired. Fraser has also held executive positions in software and technology companies in Vancouver, BC. He's also co-host of Astronomy Cast.

Phil Plait, the creator of Bad Astronomy, is an astronomer, lecturer, and author. After ten years working on the Hubble Space Telescope and six more working on astronomy education, he struck out on his own as a writer. He has written two books, dozens of magazine articles, and 12 bazillion blog articles. He is a sceptic and fights misuses of science as well as praising the wonder of real science.

Emily Lakdawalla is the Science and Technology Coordinator for The Planetary Society. She received a Bachelor's degree in geology from Amherst College and then taught science to fifth- and sixth-grade children in Chicago. She went on to Brown University to study planetary geology. Lakdawalla came to The Planetary Society in 2001, and she now writes for the website and weblog, records the "Q and A" segment on the weekly Planetary Radio show and occasionally contributes to the Society's bimonthly magazine, The Planetary Report.

Jordan Raddick is an Education and Public Outreach Specialist in the Department of Physics and Astronomy of the Johns Hopkins University. He maintains the SkyServer website of the Sloan Digital Sky Survey and the virtualobservatory.org website of the National Virtual Observatory.

Similes and Superstrings: Writing to Clarify the Cosmos

Resources

Matthew McCool
Southern Polytechnic SU
E-mail: mmccool@spsu.edu

Key Words

Astronomy Communication
Science Writing

Summary

This paper outlines our strategy for explaining good writing through astronomy. The overarching goal of our paper is to connect the field of astronomy with the process of writing and to demonstrate how writing about astronomy can produce writers who also learn about astronomy.

Writing is perhaps the greatest of human inventions, binding together people, citizens of distant epochs, who never knew one another. –Carl Sagan

Writing about astronomy

In a recent paper, Garland & Ratay (2007) outlined an instructional method for teaching writers the basic principles of astronomy. Their techniques signalled a departure from conventional methods because the strategy was not based on laboratory testing and experiments; their method was literary. Students were given the task of writing about astronomy to *learn* about astronomy, a method that successfully reached a group of beginning writers. Their premise was based on the assumption that language is an ideal platform for shaping the abstract into the concrete.

This is not as counterintuitive as it may appear because writing nudges an author into a sense of understanding and forced concentration. It is not unusual for an author to admit to having a clearer picture of a problem after writing. For reasons not entirely understood, the writing process can draw clarity from confusion. But writing is not always so elegant. In fact, the most common problem with writing of any sort, especially when the topic is astronomy, is lack of clarity. One of the stock concerns for any writing instructor addresses the common problem of verbal confusion. Unclear writing, so the saying goes, is a sure sign of unclear thinking. Even a seasoned veteran of clear and concise prose must acknowledge this issue, since writing is nothing if not the process of communication.

But rather than teaching astronomy through writing, our goal is to teach writing through astronomy. The similarity is actually quite close. As professors who are responsible for teaching effective writing in science and technology, it is our goal to teach the elements of good prose through the equally interesting elements of science. Astronomy, it turns out, is an ideal platform for our cause. It even turns out that many of our astronomy writers learn something about physics.

Survival of the clearest

Language is a critical dimension of human nature, one that separates us from all other animals (Pinker, 2005). True, other animals are thought to have at least some rudimentary ability to exchange information. Whales can send sonic waves across an entire ocean. Elephants trumpet their tunes across miles of arid plains. Birds chirp in sweet and melodic song. But only humans have the ability to use language to communicate the cosmos, which is why clarity and concision are so important.

Deborah Blum is a Pulitzer Prize-winning science journalist and professor of science writing at the University of Wisconsin at Madison. In her edited collection, *A Field Guide for Science Writers*, Blum outlines a series of key principles for effectively communicating complex topics (2006). Many of the principles outlined in Blum's book concern most forms of applied writing, but three points are particularly useful for writing about astronomy. Consider the following principles, each of which is designed to refine a complex topic into its most essential parts (2006):

- use clear and concrete prose;
- when possible, rely on non-examples;
- use analogies and metaphors.

The first principle, clarity and concreteness, addresses a reader's need to latch onto a tangible idea. Even theoretical concepts need a conceptual anchor (cf. Greene, 2004; Sagan, 1980). The second example, or non-example, is more exotic, but no less effective. Many people assume, for instance, that antimatter means no matter. A writer can anticipate her reader's assumption and counter it with a non-example. The author may state that antimatter does not mean "no matter", but is actually "invisible" matter. While the non-example does not have to be technically accurate it must be able to explain a concept by what it is not. The third principle of clear writing, analogy and metaphor, is equally useful. Nearly all scientific pursuits rely on simile, analogy and metaphor for effective communication. Consider a case in human genetics.

Recent advances in genetics are now providing an opportunity to determine our ancestral origins. The problem is that most people do not want to have a conversation about genetics, chromosomes and biomarkers. But it is possible to express the same ideas through an analogy. Many soups are based on family recipes passed down through generations. A family may relocate from Ireland to the US, but the soup recipe remains more or less the same. The reason soup recipes are useful is that they contain ingredients that indicate specific geographic regions. For instance, perhaps all Irish soup recipes are known for using celery. By studying all soup recipes in the US, you can deduce from their ingredients whether a recipe is from Ireland or some other region. By reverse engineering a recipe, you can determine where it was originally from and how it changed.

The beauty behind this example is that writing, or specifically, the metaphor of genetic soup, accomplishes two tasks. First, it explains a complex problem in genetics to a reader who lacks the training of geneticists. Second, the process of designing and writing about a genetic soup metaphor also benefits the writer by turning an abstract concept into a concrete, everyday experience. This is the same strategy used in successful astronomy communication.

The science writing process

Teaching the principles of science writing requires a process for filtering the simple from the complex. In his book, *Being Logical*, philosopher D. Q. McInerny said it best when he described the need to adapt technical topics for a non-technical audience (2005):

If you are a physicist discussing the principle of indeterminacy with other physicists at a professional conference, you can freely use the technical jargon of your profession. But if you are asked to explain that principle to a group of non-physicists, you should adjust your vocabulary and present your material in ordinary language. Don't use technical or "insider" language merely to impress people. The point is to communicate. The two extremes to be avoided are talking down to people and talking over their heads.

Notice McInerny's claim that the "point is to communicate", which means the writer is responsible for clear communication (cf. Gater, 2008; Greene, 2004). This assumption is partly based on the idea that language is thought to be a reliable vehicle for exchanging information. In other words, if you do not understand this sentence then it is not your fault, or even the limitation of words. Instead, we are responsible for poor writing and miscommunication.

On the other hand, poetic language can greatly improve the delivery of complex ideas. Aristotle believed that the use of metaphor exemplified the higher signs of intellect: *"The greatest thing by far is to be a master of metaphor. It is the one thing that cannot be learnt from others; and it is also a sign of genius, since a good metaphor implies an intuitive perception of the similarity in dissimilar."* (Aristotle/McKeon, 2001) Calling users of metaphors geniuses may be a bit excessive, but metaphors have a clear role in expressing a range of tough topics. Science writers readily grasp this literary device and are eager to incorporate its use within their own work.

From similes to superstrings

Simile and metaphor are two types of literary techniques known as *tropes*, distinguished only by a minor difference (Kövesces, 2002; Lakoff & Johnson, 2001). Metaphor is when one thing can be substituted for another. Item *A* can replace item *B* because both have identical properties. A simile is when one thing is likened to another. Item *A* is said to be *like B* because they have similar, but different properties. Many people use the word metaphor when they really mean simile, but this is an unimportant technical distinction. The point here is to remember that both simile and metaphor have long been used (at least since Aristotle) to explain one thing in terms of something else.

Our strategy for teaching effective astronomy writing is based on using simile and metaphor as part of a three-stage process. The first stage begins with a simple idea. The second stage builds on the original idea. The third and final stage combines elements from the first two stages to create a clear and accessible image for the reader. Although the exercise is based on developing good writing skills, most writers walk away from the project with a deeper understanding of the cosmos (or in this instance, superstrings). Consider the following three-part example, which is taken from an exercise whereby writers assemble a method for explaining string theory to a general reader.

Step 1 (build the foundation): The first stage entails splitting a complex problem into two parts (we aim to do this with most scientific topics). Although some problems require a third perspective, the issue of string theory fits neatly within a dual framework. Thus, writers are then asked to outline the two sets of seemingly incompatible laws defining the Universe — the smoothness of Einstein's theory of gravity and the jitteriness of quantum mechanics. Students are then asked to briefly define these two theories, gravity and quantum mechanics, in terms of everyday experience.

Step 2 (layer detail): The second stage entails overlaying some complexity onto the first stage. In this instance, writers are asked to add detail to their original example by equating each kind of physics as a distinct kind of "musical language". Novice writers accomplished this task by explaining that each theory speaks a different language, but they lack a common protolanguage. Because both "languages" are correct, a third "musical language" must connect the two theories.

Step 3 (connect through the concrete): The third stage entails connecting the simple first stage and the slightly more detailed second stage, thereby creating a concrete third stage. Thus, writers are asked to hone in on the idea of music as a simile for bridging both theories. This is based on the idea that language and music share similar tonal qualities. The "strings" connecting the two laws of nature are equated with a "harmonic bridge", a kind of musical apparatus connecting both languages. Thus, the simile is that a harmonic bridge is like a string.

Writers are then asked to rationalise their simile. In the example given above of a harmonic or musical bridge, the simile is rooted (according to most writers) in the universal nature of sound and music. Everyone has an intuitive sense of harmonics, even if they lack a technical command of the subject. Further, music crosses every culture without the aid of a natural language. While a harmonic bridge hints at a similarly abstract idea it actually taps into a deep and primal impulse for rhythm and sound. Although imperfect, many writers argue that music's universal nature can link the abstraction of both theories for most readers.

Discussion

A nice side effect of teaching science writing through astronomy is that novice writers — namely, undergraduates in applied fields of science — learn quite a bit about astronomy. Even astronomy majors are surprised by their increased level of understanding. Although astronomy students bring greater depth to the workshops, our approach brings greater breadth. But writing about astronomy has other selling points.

As with using writing to learn about astronomy, our process of using astronomy to learn about writing can be easily ported to similar environments. While travelling, for instance, we regularly visit science museums and planetariums that feature outreach programmes and in-house activities for all ages. A brief writing exercise would be ideal for at least some of these venues because it burns a deep imprint of the subject in the participant's mind. That in itself is reason enough to rethink astronomy in respect to writing, since few topics are more interesting or enjoyable than contemplating our little corner of the cosmos.

References

- Aristotle 2001, *Poetics, The Basic Works of Aristotle*, (New York: Modern Library), 1455-1487
- Blum, D., Knudson, M. & Henig, R.M. 2006, *A Field Guide for Science Writers*, 2nd Editon, (New York: Oxford University Press)
- Garland, C.A. & Ratay, D.L. 2007, *Using Literacy Techniques to Teach Astronomy to Non-science Majors*, Astronomy Education Review, 6, 1
- Gater, W. 2008, *Why Should we Bother to Communicate Astronomy?*, Communicating Astronomy with the Public Journal, 2, 30
- Greene, B. 2004, *The fabric of the cosmos: space, time, and the texture of reality*, (New York: Alfred A Knopf)
- Kövesces, Z. 2002, *Metaphor: A Practical Introduction*, (New York: Oxford University Press)
- McInerny, D.Q. 2005, *Being Logical: A Guide to Good Thinking,* (New York: Random House)
- Montgomery, S.L. 2003. *The Chicago Guide to Communicating Science*, (Chicago: University of Chicago Press)
- Pinker, S. 2005, *So How Does the Mind Work?*, Mind & Language, 20, 1
- Sagan, C. 1980, *Cosmos*, (New York: Ballantine Books)

Biography

Matthew McCool studied intercultural communication at New Mexico SU (USA), literature and philosophy at the University of Illinois at Springfield (USA), and neuroscience at the SIU School of Medicine. He has just released a book about intercultural writing called *Writing around the World* (Continuum).

Visualising Astronomy: Playing Host

Ryan Wyatt
California Academy of Sciences
E-mail: rwyatt@calacademy.org

Key Words

Visual Communication
Astronomy Visualisation

I recently had the opportunity to host the 2009 Astronomy Visualisation Workshop at the California Academy of Sciences in San Francisco, USA. No professional organisation of astronomy visualisers exists, alas, but we have gathered informally in different locations for the past several years. And the breadth of content has increased dramatically with each meeting. This time around, we tried to add a Bay Area twist.

As the hosting institution, the California Academy of Sciences fielded a large team, which took over the first morning's session in a lead-up to a showing of our opening planetarium production, *Fragile Planet*. Jeroen Lapré, the Senior Technical Director at the Academy, described the production process, while Jon Britton, Senior Systems Engineer, went into the nitty gritty about hardware and software requirements to support the Visualisation Studio. Tom Kennedy, producer of *Fragile Planet*, provided insight into some of the challenges that face a small studio — including resource management and scalability between projects. And I tried to provide a perspective on how visualisation fits into the Academy as a whole, making use of our spectacular venues in a way that allows for experimentation with different forms of visual storytelling.

One of the motivations for the Academy to host the workshop was to highlight some of the special venues at our institution. The Academy boasts the world's largest all-digital planetarium as well as a stereoscopic theatre that makes use of truly impressive Dolby 3D technology.

In the new Morrison Planetarium, workshop participants had the opportunity to enjoy the Academy's own production, *Fragile Planet*, as well as a special showing of *Cosmic Collisions* from the American Museum of Natural History. Mark Subbarao from Adler Planetarium also gave a live presentation with Sky-Skan's DigitalSky software, showing SDSS and other cosmological data. (One of Mark's collaborators, Miguel Angel Aragon Calvo from Johns Hopkins, gave a talk revealing some of the processes he uses to enhance structures in representations of large-scale structure data.) In the stereoscopic theatre, Michael Broxton of NASA's Ames Research Center demonstrated some of his work on neocartography, using SCISS Uniview software to showcase 3D reconstructions of the lunar surface from Apollo imagery.

Another motivation for hosting the conference in the Bay Area was to coincide with the California Symphony's performance of *Astronomical Pictures at an Exhibition*,

Figure 1. Shalini Venkataraman (left) from NVIDIA and Doug Roberts (right) from the Adler Planetarium pose in front of a roughly 4K tiled display on the floor of the California Academy of Sciences. Credit: Stuart Levy.

with 3D imagery assembled by the Adler Planetarium's own José Francisco Salgado. (Watch out for José Francisco on his globe trotting tour, too!) Also in the art vein, Kimberly Kowal Arcand from the Chandra X-Ray Center described her research into the aesthetics of astronomical imagery: an online survey reveals differences between responses from professionals and novices, offering some tantalising insights into people's perceptions of our work.

Some of the Bay Area participants represented local companies involved with work that touches on the visualisation and educational and public outreach communities. CoCo Studios' Barrett Fox introduced CoCo Deep, the company's video-game-styled interface to multimedia content and collaboration. Justin Boitano and Shalini Venkataraman, both from NVIDIA, used the Academy's "Science in Action" exhibit to demonstrate their Quadro Plex multi-GPU system, which allows tiled monitors to be treated as a single, continuous display (Figure 1). Craig Barron, whose company Matte World Digital recently shared an Academy Award® for historically accurate cityscapes in *The Curious Case of Benjamin Button*, ruminated on Hollywood's depictions of the Red Planet and how they might become better informed by current research.

Another Bay Area local, David Rees, Group Lead for Adobe Acrobat, previewed some spectacular features in Acrobat that support three-dimensional content. The talk dovetailed neatly with a presentation from Chris Fluke at Swinburne University, who introduced his team's *s2plot* software along with some spiffy ideas for incorporating three-dimensional content into research papers[1].

A sizeable team of students showed up from California State University at Los Angeles, led by Milan Mijic. The interdisciplinary group, called SciVi[2], brings together undergraduates and graduates from the Art and Computer Science departments as well as Physics and Astronomy to create short videos and games around the general topics of cosmology. They've produced a few pieces already, and I look forward to seeing more of the work that emerges from this programme.

I always appreciate talks that step back from the day-to-day deluge of projects to consider the quality of work that we produce. This time around, I particularly enjoyed Robert Hurt's reflection on "Visual and Narrative Synergy for Communicating Technical Concepts". Robert selected an example from his *Hidden Universe* podcast and invited workshop attendees to critique the density of information and the style of presentation (Figure 2). This kind of post mortem offers a critical opportunity to continue improving our work; in the planetarium field in particular, we need to do it more often.

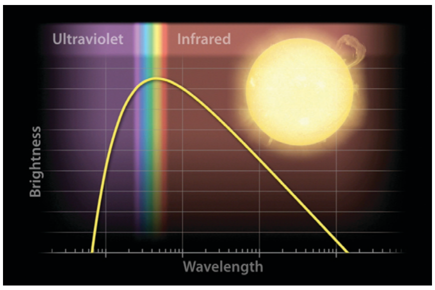


Figure 2. A frame grab from the Spitzer Space Telescope Hidden Universe *podcast showing a lot of information, but of course, lacking the context that a moving image and soundtrack provide. Credit: Spitzer Space Telescope/R. Hurt.*

Doug Roberts from the Adler Planetarium also gave a thoughtful talk on how to make "magic" happen for visitors to an exhibit — how to balance the technical and financial realities of a design in a way that still allows for a suspension of belief on the part of audiences.

The workshop closed with filmmaker Angela Christian presenting portions of and teasers for her work in progress about some of the folks in the astronomy visualisation community. Seeing ourselves (often, literally, ourselves) from an outsider's perspective made for a surprising and moving culmination to the workshop.

I wish I had space to describe the other delightful and insightful presentations at the workshop! Not to mention the intriguing side conversations and serendipitous moments that graced the event. Playing host provides an exhausting but rewarding opportunity to engage with one's colleagues, to show off a little, and to share a lot. I hope people enjoyed coming to San Francisco as much as I enjoyed having them here.

Notes

[1] http://astronomy.swin.edu.au/s2plot/
[2] http://sci-vi.calstatela.edu/

Biography

Ryan Wyatt is the Director of Morrison Planetarium and Science Visualization at the California Academy of Sciences in San Francisco, California, USA. He writes a somewhat regular blog, "Visualizing Science", available online at http://visualizingscience.ryanwyatt.net/

TRUE 3D PRINTS

NETWORK OF OUR PARTNERS OVER EUROPE (short list):

NATIONAL MARITIME MUSEUM, GREENWICH, U.K.
TEKNISKMUSEUM, OSLO, NORWAY
ASSOCIAZIONE APRITICIELO, PINO TORINESE, ITALY
PLANETARIUM, PRAHA, CZECH REPUBLIC
PLANETARIUM, WIEN, AUSTRIA
SCIENCE GALLERY, DUBLIN, IRELAND
PLANETARIUM, BRNO, CZECH REPUBLIC
AHHAA, TARTU, ESTONIA
HEUREKA, VANTAA, FINLAND
DANFOSS UNIVERSE,NORDBORG, DENMARK
NOBEL MUSEUM, STOCKHOLM, SWEDEN
MUSEU DA CIENCIA, COIMBRA, PORTUGAL
COSMOCAIXA, BARCELONA, SPAIN
PLANETARIUM, ZIAR N/H, SLOVAKIA
TIT PLANETARIUM, BUDAPEST, HUNGARY
CITE DE L´ESPACE, TOULOUSE, FRANCE
NEMO, AMSTERDAM, THE NETHERLANDS
TECHNOPOLIS, MECHELEN, BELGIUM
MBM SYSTEMS, DRESDEN, GERMANY
PLANETARIUM M.KOPERNIKA, TORUN, POLAND
CITÉ DES SCIENCES PARIS, FRANCE
CIUDAD DE LAS ARTES Y LAS CIENCIAS VALENCIA, SPAIN
PARQUE DE LAS CIENCIAS GRANADA, SPAIN

WORLDWIDE UNIQUE THREE-DIMENSIONAL PRINTS...

...BASED ON SATELLITE PICTURES, 3D DATA MODELS AND EVEN ON REGULAR IMAGES

3D

PLANET EARTH PLANETARIUM SERIES

SUN AND MOON PLANETARIUM SERIES

PLANETS PLANETARIUM SERIES

SOLAR SYSTEM AT A GLANCE

THE UNIVERSE LIMITED EDITION

SPACE MILESTONES & TECHNOLOGY

WWW.MAPCARDS.NET PRODUCTS
ARE DISTRIBUTED WORLDWIDE BY:

MORAVAC s.r.o.,
Vinohrady 29, CZ 639 00 BRNO
partners@mapcards.net
phone: +420 603 197 474
fax: +420 530 340 873

www.mapcards.net

CAPjournal submission guidelines

We are keen to encourage readers to submit their own articles, reviews, etc. Some key points are addressed below.

Technical and esoteric language should be either avoided or used with a footnoted explanation if absolutely required. All contributions will be made to conform to British spelling and punctuation practice. Figures and tables should be referred to 'Figure n' and 'Table n' respectively. Acronyms should be spelt in full once and then parenthesised; henceforth they can then be used as lettered acronyms. Numerals should be used for numbers greater than two words and always for numbers greater than ten.

Manuscripts should be delivered in MS Word or text (.txt) format, with no formatting apart from bold, italics, super- and subscripts. Hard carriage returns after each line should be avoided, as should double spacing between sentences. If the contribution contains figures, these may — just for the sake of overview — be pasted inline in the Word manuscript along with the caption (Word files below 4 MB are encouraged). However, images must also be delivered individually as Tiff, PDFs, vector-files (e.g. .ai, .eps) in as high a resolution as possible (minimum 1000 pixels along the longest edge).

Copyright

Authors are solely responsible for ensuring copyright clearance to reproduce illustrations, text, etc., for which they themselves do not own the copyright. CAPjournal accepts only original submissions and will only reproduce previously published work by special arrangement.

Contact

Submissions should be sent to the Editor:
editor@capjournal.com

Submit articles for one of the following journal sections:

- Announcements
- Reviews
- News
- Resources
- Innovations
- Research & Applications
- Letters to the Editor
- Opinion
- Best Practices
- Interviews

www.capjournal.org

Online issues
Free subscriptions
Article submission

Sponsors

esa · ESO