

# On-line Museums

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**Résumé.** Le réseau mondial Internet — le «réseau des réseaux» — permet aux organisations, qu'il s'agisse de simples individus ou de compagnies multinationales, de rendre l'information plus facilement et rapidement accessible que jamais à l'échelle globale. Plus particulièrement, le World Wide Web (WWW) permet l'accès à des ressources hypermédias sous une forme utilisable par la majorité des utilisateurs. Comme d'autres, les musées sont particulièrement intéressés par les possibilités croissantes de l'Internet. Cet article présente quelques musées qui utilisent l'Internet, les pages «musées» de la Bibliothèque Virtuelle (pmBV) offrant un répertoire des musées en ligne, et des statistiques de «visites» des musées en ligne. Enfin, quelques possibilités de développements futurs sont explorées.

**Keywords:** Internet, on-line exhibits, virtual museum, World Wide Web. **Mots-clés :** Internet, expositions en ligne, musées virtuels, World Wide Web.

## 1. Background

In 1979, Christopher Evans wrote a book called *The Mighty Micro* on the impact of the computer revolution. In it he predicted the following:

The world of the 1980's and '90s will be dominated not only by cheap electronic data processing, but also by virtually infinite electronic data transmission.

Perhaps he was over optimistic about the “virtually infinite electronic data transmission”, and also about the timing of the revolution, but with the advent of the Internet global network of networks in the commercial sector as well as the academic sector, electronic digital data transmission is increasingly important in the modern world.

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Wide area networking of computers started in the USA as long ago as the 1960s. In 1969, the ARPAnet was launched with four nodes, which is the origination of the Internet as it exists today. The Internet consists of a large number of interlinked networks, all supporting the ubiquitous TCP/IP protocol. In the UK, for example, JANET has connected academic sites for well over a decade. This forms an important part of the 'Net' (the colloquial term for the Internet) in the UK.

Nicholas Negroponte in his book *Being Digital* published in 1995 has the benefit of a further 16 years of watching developments over Christopher Evans (1979). He comments:

Like a force of nature, the digital age cannot be denied or stopped. It has four very powerful qualities that will result in its ultimate triumph: decentralizing, globalizing, harmonizing, and empowering.

The network has no overall control, yet it allows worldwide communication in a remarkably effective manner. As other industries such as publishing and broadcasting become increasingly digital in nature, all will begin to merge in an as yet unpredictable manner. Yet on the Net, the individual can be as powerful as a multinational corporation. Content is all-important to attract customers on-line.

Fortunately for museums, content is something that they have in abundance. The only barrier, apart from financial considerations, is the mastering of the technology which allows this to be unleashed to the on-line world.

### **The World Wide Web (WWW)**

A major reason for the explosive expansion of the Internet is the emergence of the World Wide Web (WWW) [Berners-Lee, 1994] over the past few years. This provides a global hypermedia system which has spread in use on the Internet extremely rapidly. A major reason is its easy of use; previously searching the Internet for information involved text-based interfaces requiring the typing of complex commands to retrieve the desired data. This made it the preserve of technical experts. In contrast, the 'Web' provides a graphical 'point and click' interface, that is manageable by the majority of people even after only a few minutes practice.

In overview, the WWW consists of a large number of geographically distributed 'server' computers providing data in the form of text, graphics,

sound, etc., and an even larger number of 'client' computers (typically running a WWW program such as *Netscape* or *Mosaic* on a personal computer or workstation) which collect and format this information into a displayable form suitable for viewing on a screen (and sometimes, although still quite rarely, in audio form too).

The person accessing the information is normally presented with a page of textual and graphical information with a number of highlighted phrases or graphical icons which provide 'hyperlinks' to other on-line resources. To navigate the system, the user simply points to one of these items and selects it, normally using a 'mouse'. This interface comes very naturally to most people, hence making it much more usable than previous navigation tools on the Internet.

A major part of the power of the system comes from the fact that the hyperlinks may lead to a range of different resources which can come from a server anywhere in the world on the Internet. As well as standard WWW pages, the resource could be a sound, a movie, a search of a database, an on-line news article, or an electronic form for user input.

Information may also be generated by a computer program at the server site, allowing a page to be tailor-made for the user, perhaps depending on information provided via an interactive menu or form. This allows the possibility of remote interactive exhibits, an aspect which has yet to be exploited greatly by many museums. New types of resource, such as virtual reality, continuous video and audio, etc., are becoming possible, depending on the network bandwidth available, boding true networked multimedia in the future.

A recent addition to the list of potential resources is the Java 'applet', which essentially consists of a general purpose program downloaded with a WWW page, allowing dynamic areas of the page presented to the user, with increased possibilities for interactivity. This is likely to have a significant effect on the resources available on-line, and heralds exciting possibilities for museums to produce interactive exhibits accessible worldwide.

The rest of this article covers aspects of the Internet relevant to museums who have already or are considering making on-line information available as part of the range of services which they offer.

## 2. Some examples of on-line museums

Museums from all over the world are already providing on-line resources. Probably around one to two museums a day are joining the network. Many are large national institutions, but others are much smaller and simply have an expert with enough knowledge and enthusiasm to make some information or a 'virtual exhibition' available on-line. Of course, the museum experience on-line will be very different on-line compared to visiting an actual museum, and it is important that museums provide on-line material which will be of interest to visitors (Strimpel, 1995). Ideally virtual visits should promote a real visit where this is physically possible. In this section, a small selection of resources provided by some museums and related organizations is presented and briefly discussed.

The USA has easily the largest number of museums on-line of any country in the world. One of the largest and most well known US museum (or rather set of museums) is the Smithsonian Institution based in Washington DC. This provides a very comprehensive set of on-line pages, with several WWW servers for individual Smithsonian museums, including an on-line newsletter and substantial on-line exhibitions complementing actual exhibits, especially for major new exhibitions. There is even a mirror site in California to improve access speed across the nation. The extensive use of graphics, video and audio by the Smithsonian, while providing an excellent resource, does make appreciation of the material difficult from outside the USA.

In Canada, the Canadian Heritage Information Network (CHIN) have initiated an excellent on-line infrastructure for museums, providing a countrywide directory of museums by province. In addition, the use of WWW pages is very helpful in a multilingual country such as Canada since parallel sets of pages can be maintained almost transparently to the reader. Many museums in Canada provide both English and French information on-line.

In the UK, the Natural History Museum in London was the first museum with its own WWW server (connected via Imperial College who are fortuitously on an adjoining site, which makes network access relatively easy). Resources include virtual reality exhibits of fossils, allowing three dimensional manipulation of the objects. The Science Museum, also close by, installed a WWW server soon afterwards, partly through peer pressure, and now provides the most comprehensive set of pages of any UK museum. This includes information on related satellite museums and an increasing number of virtual exhibitions.

The River and Rowing Museum at Henley-on-Thames is an interesting example of a museum with on-line information since the museum is still being built and has not yet opened to the public. The museum covers the non-tidal section of the River Thames and the international sport of rowing, as well as the town of Henley itself, the home of the historic Henley Royal Regatta. Having an on-line presence allows the museum to make press releases and other information available to a geographically distributed readership. There are thousands of rowers with on-line access around the world, since many are at universities which traditionally have already had good network connections for many years. Artists impressions of the proposed galleries, and resources such as a comprehensive set of photographs of the River Thames, made available by a volunteer, are also accessible from the museum's WWW pages. It is perhaps the first museum to be started virtually, before it has actually been built. The resulting publicity has brought in offers of volunteers, objects, and even virtual curators for on-line collections.

The French Ministry of Culture provide some excellent on-line exhibits and database resources, such as the JOCONDE database of more than 130,000 records describing paintings and sculptures in France's national museums. One interesting on-line resource is the presentation of a set of newly discovered Palaeolithic cave paintings near Vallon-Pont-d'Arc, which cannot be opened directly to the public because of the potential damage, but which can be made instantly available to millions of people around the world with Internet access. Such a readily available exhibit would be impossible with any other technology. For the future the potential of presenting the cave as a virtual reality experience is an interesting and exciting possibility.

Elsewhere in Europe, the Netherlands Tourist Board provides basic information on-line for every museum in the country—surely an aim for all countries with Internet provision. Greece provides a virtual tour of the Acropolis directly from Athens, as well as an excellent cultural resource providing information on museums and other sites of interest throughout the country.

A significant number of countries now have museums which provide on-line information. Examples from all continents except Antarctica are available.

## Virtual museums

A number of entirely virtual museum sites exist on the network, with no real museum counterpart. The most famous of these is the WebMuseum. Originally misnamed the WebLouvre, this caused consternation to the real Louvre who naturally insisted on a change of name. Indeed, many people confuse the site with the Louvre; such confusion is a hazard when accessing on-line information. The site was started by a teenage Frenchman, Nicholas Pioch, who produced such an excellent resource that it has been mirrored (copied) at many Web sites around the world. These mirror sites make access much faster if a relatively local site is used. This is a real issue if large graphical files are to be downloaded in a reasonable amount of time, and has contributed considerably to the success of the resource.

The WebMuseum provides excellent on-line exhibitions of many famous paintings and has been set up for non-profit educational purposes. The site is dynamic, with special exhibitions being added periodically. It has proved extremely popular; the WebMuseum network delivers around 10 million documents per week to an estimated 200,000 visitors.

Many virtual museum sites are the result of personal interests. On 1st June 1995, with an interest and knowledge of both museums and computing, I decided to set up an on-line Virtual Museum of Computing, providing a collection of hyperlinks to local and remote resources on the history of computing that could be very hard to discover otherwise. It includes links to major computer companies—for example the original garage where Hewlett-Packard was founded may be viewed from the company's server. It also provides many links to other on-line computer-related museums. The resource has been cited by the Discovery Channel and the *IEEE Annals of the History of Computing* (Bowker, 1996), as well as being selected as a 'Top 5%' Web site by Point Communications, a company providing a directory of selected and reviewed high-quality on-line resources.

A virtual museum allows the possibility of 'virtual curators', who may be located anywhere in the world. For example, the Virtual Museum of Computing includes a section or 'gallery' on Alan Turing, one of the early pioneers of computing, maintained by the author of Turing's definitive biography (Hodges, 1992), Andrew Hodges, on a completely different Web server.

Virtual museums can be much more responsive and dynamic than real museums through the nature of the medium. The original Virtual Museum

of Computing site was set up in a day and by the end of the week it had around a hundred virtual 'visitors' each day. Links to further resources can be added at will, using feedback via email from visitors, and on-line searches.

### **Copyright issues**

The provision of images on-line presents interesting copyright issues which have yet to be solved in the fast moving network world. Many museums are worried about making images available on-line, but some have less reservations. For example, the Museum of the History of Science in Oxford has made extremely high resolution images available which mean that the exhibits can be viewed in as much detail on the screen as they can in real life. This was done precisely because of the fact that many museums who do have a Web presence, still do not provide much of real scholastic value on-line. Some extremely large and important museums (for example, the British Museum in London) still have no on-line presence, apparently at least partially due to copyright worries.

### **3. The Virtual Library museums pages (VLmp)**

While there are a large number of museums providing on-line material, finding an individual museum can be problematic. There are a number of WWW search engines which can be given one or more keywords (the name of a museum for example), but this is often a somewhat hit and miss affair, and can produce spurious results. To help overcome these difficulties, the WWW Virtual Library museums pages (VLmp) [Bowen, 1995a, 1995b] provide an interactive directory of on-line museums. Virtual 'visitors' can select a hyperlink to a museum of their choice (categorized by country) and view on-line hypermedia information and exhibits provided by that museum.

### **Beginnings**

In 1994 I discovered some on-line information provided by a small number of museums, mainly in the US, available on the World Wide Web. My wife is a museum director, and I enjoy visiting museums, so I decided

to form a personal collection of on-line museums, in the form of a directory with hyperlinks directly to each of the museums concerned.

The inventors of the WWW, then based at CERN in Switzerland, had also started a catalogue of information available on-line around the world known as the WWW Virtual Library. Individuals were (and still are) invited to maintain pages of on-line links in specialist subjects, and I volunteered to include my collection of museums in the library. This quickly became a very popular WWW page.

### **Contents and structure**

The Virtual Library museums pages include museums from all over the world. Initially the resource consisted of a single page providing links to individual museums around the world. The number of on-line museums now makes this impossible because the page would be too large for convenient downloading internationally. To cope with the scaling problem, museum lists for individual countries are now split into separate pages as the number of museums in a particular country warrants this. The first to be separated was the USA, which probably has around half the on-line museums in the world within its borders. It is likely that the USA page will need splitting by state (say) in not too distant the future.

Other countries with their own VLmp page include Canada, Spain, Sweden and the UK. Countries not listed separately are combined together in a 'rest of the world' page. The total number of countries in the world which have on-line museums listed in the VLmp pages is around thirty, but is constantly growing. Every continent except Antarctica is represented within the VLmp listings.

The resource is searchable by keyword. Each entry typically has some brief information associated with it, especially if the type of museum is not obvious from its name. Brief location information for the actual physical museum is also included, although it is surprising how difficult this is to discover from many on-line museum sites.

There are many other on-line lists of museums around the world, both local and national, as well as international. The VLmp directory provides access to these resources both within country sections (for local and national lists) and as a separate page (for more international lists).

In addition to categorization by country, some listings by museum type are available (e.g., museums for children, computer-related museums and



art galleries). Pointers to related resources such as planetariums and zoos are also provided.

The VLmp resource is linked from many places on-line, including a large number of museums around the world. It is one of the most widely referenced on-line museum resources. As well as WWW hyperlinks from other sites, it has been mentioned, together with its 'URL' (Uniform Resource Locator) which allows direct access from a WWW client program, in many newspapers and magazines, such as the UK Guardian, USA Today and the New York Times.

### **Recent developments and plans**

The VLmp pages are now mirrored in Canada, Sweden, the UK and the USA. This allows faster and possibly more reliable access to the VLmp resource in different parts of the world. Since the directory is organized by country, individual countries are being encouraged to maintain separate lists that can be integrated into the overall directory. Currently the Canadian Heritage Information Network (CHIN), the Universidad Politécnica de Madrid, and the Swedish Natural History Museum, maintain directories for Canada, Spain and Sweden respectively within the overall VLmp structure.

The International Council of Museums (ICOM) recognize the importance of the Internet in forging links in the museum community globally, and have expressed their willingness to mirror the VLmp resource at their own WWW site and other ICOM mirror sites around the world. ICOM members around the world are encouraged to maintain VLmp pages for their own countries as resources and expertise allow. Hopefully this will ensure the long-term viability of the VLmp directory.

### **4. Visitor statistics**

There are estimated to be around 35 million people with Internet access worldwide, although exact numbers are difficult to measure, and Internet traffic is doubling approximately every ten months. WWW usage has been estimated to be increasing at 1 % per day, equivalent to a doubling every three months.

Since its inception in 1994, the main VLmp 'home page', which represents the equivalent of the front door for the site, has received about half million visits, with around 1,500 a day recently, easily the most popular page at its site. It is also one of the most popular pages in the WWW Virtual Library, normally in the top ten for which statistics are available. More recently it has proved second only in popularity to the 'home pages' section of the Virtual Library, which provides links to personal pages on individuals.

Table 1 shows the number of accesses to the VLmp home page by month from August 1994 until February 1996. These figures are collected by processing the WWW server log file which saves a line of information for each access. They require some interpretation in terms of numbers of people accessing the site.

Table 1  
WWW Virtual Library museum page 'visits'

Month	VLmp home page 'visits'
8/94	3,459
9/94	8,749
10/94	12,575
11/94	14,997
12/94	17,284
1/95	21,143
2/95	24,482
3/95	32,251
4/95	29,458
5/95	25,436
6/95	23,298
7/95	20,534
8/95	19,562
9/95	21,204
10/95	20,804
11/95	26,087
12/95	29,463
1/96	32,389
2/96	43,849
Total	442,702

Initially the number of visits doubled approximately every three months. From March to October 1995 the apparent visitor figures declined,

and since then they have increased, again doubling approximately over a three to four month period. The mid-term decline is probably due to two reasons. Firstly, the pages were split up at the beginning of this period, thus allowing 'visitors' to enter the VLmp site from pages other than the main home page. This is rather like visitors entering a museum via a side door rather than the main door, making counting of visitors more difficult. In addition, and probably more importantly, proxy cacheing was introduced during this period. This allows WWW client programs to access WWW pages via a local site where popular pages (such as VLmp) may already be stored. This saves copying files large distances across the world, but makes monitoring of file accesses more difficult. Thus the accesses in Table 1 probably represent a lower bound on the actual numbers of on-line visitors, which could be significantly higher.

Another way of counting on-line visitors is to include a counter program run on the WWW server which records the number of accesses in a file and generates a graphics image which displays this number in the WWW page being accessed. This is only updated on WWW client programs which display graphics in-line, although this is likely to be a fairly large percentage of the total nowadays. This technique allows the counter to be included in a number of pages, thus overcoming the problem of visitors not entering by the main home page. Because images are normally cached locally by WWW client programs, subsequent accesses to other VLmp pages by the same person are not counted twice (unless a page is completely reloaded by the user). This style of logging has been used more recently on the VLmp pages. In March 1996 there were 38,605 accesses and in April 1996 there were 40,817 accesses recorded using this technique.

Other statistical information for the museums pages for the month of April 1995 is available on-line, linked from the VLmp main page. The information includes a breakdown of accesses by country (Bowen, 1995b). This indicates that by far the highest usage is from the US, although most other countries in the world are represented in the full list to some degree, apart from many in Africa. US statistics allow breakdown by academic and commercial site access. Originally there were more accesses from academic sites to VLmp, but now the reverse is true. Most of the recent expansion of the Internet has been in the commercial rather than the academic sector.

The hourly statistics as presented in Figure 1 indicate that the level of accesses follow US working hours, when the access rate peaks at around three times the minimum level. Weekday accesses are typically almost twice

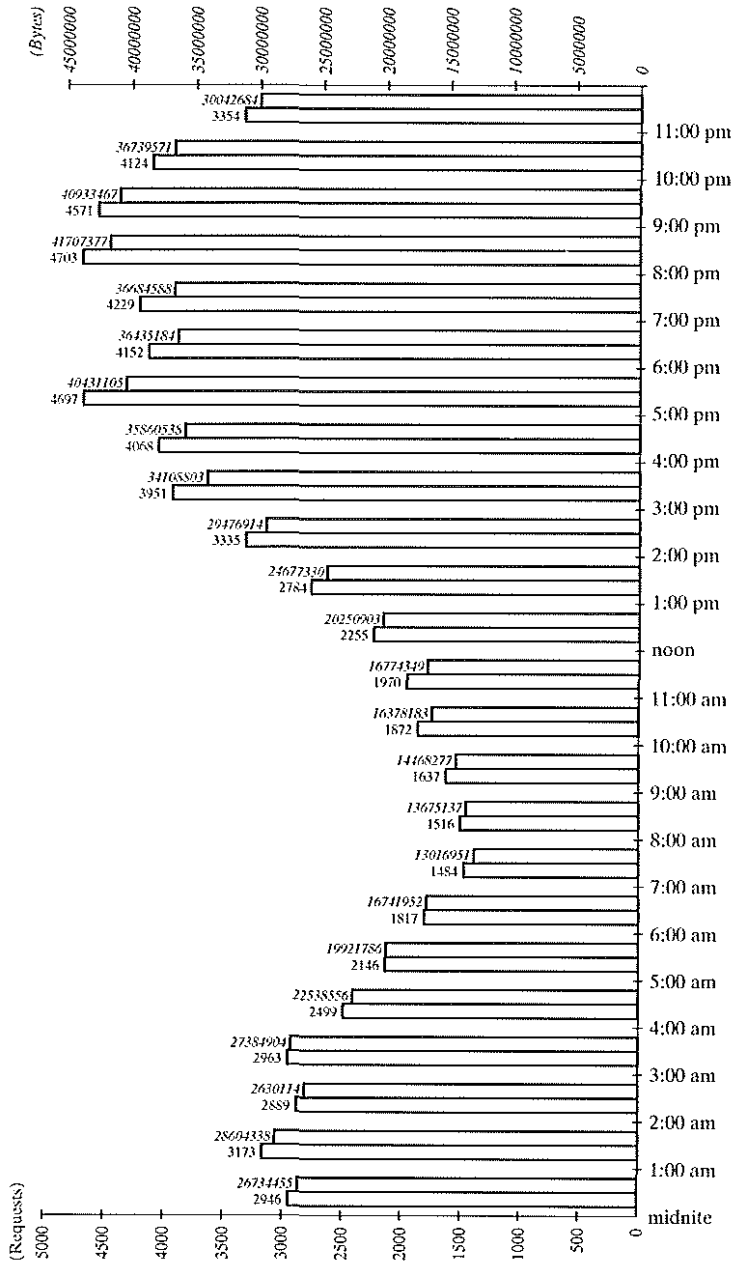


Fig. 1.- Accesses (requests and bytes) to VLmp pages by the hour during April 1995

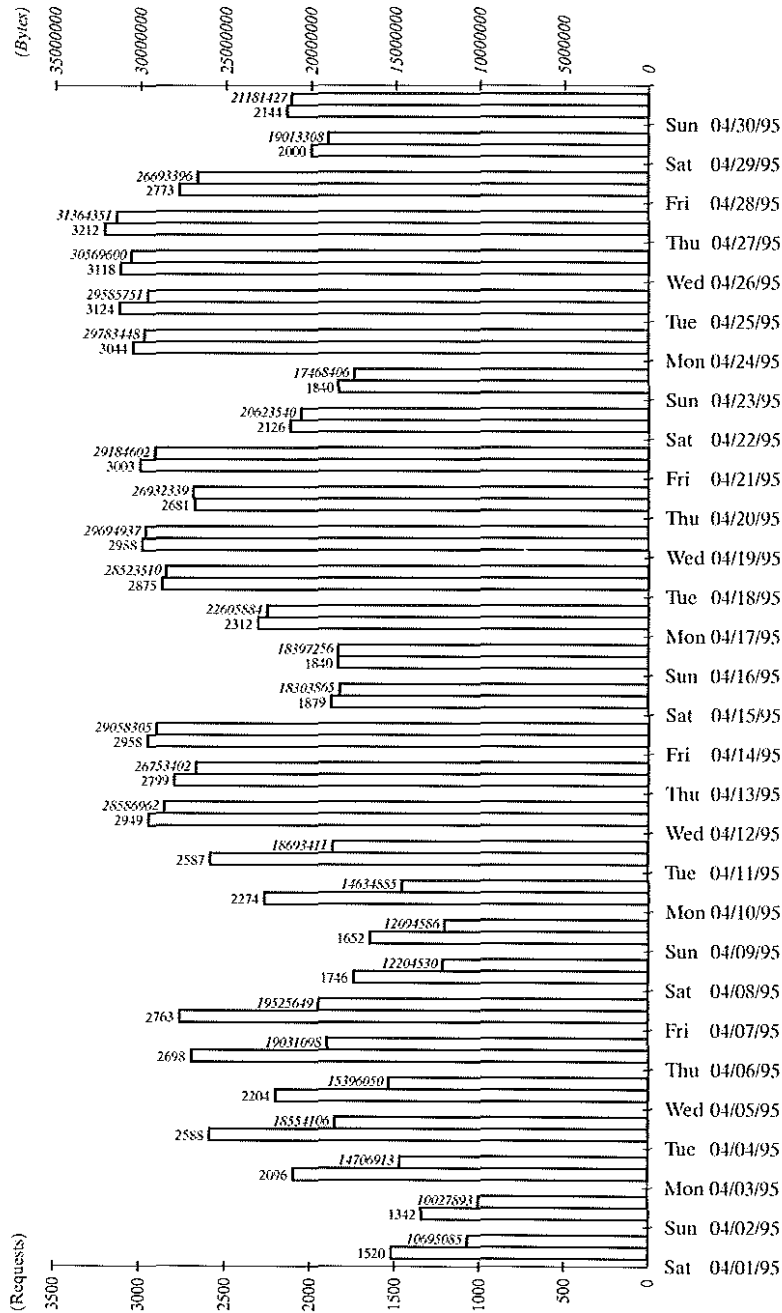


Fig. 2. - Accesses (requests and bytes) to VLmp pages each day for the month of April 1995

those at weekends, as can be seen in Figure 2. This also shows the rise in the number of accesses as the month progresses. Since weekend accesses are reduced, it may be assumed that most people are accessing the museums pages at their workplace. This is exactly the opposite of real museum visits. However, as network access from the home increases, this difference appears to be lessening.

## 5. Possible Future Directions

Hundreds of Internet 'providers' around the world now allow telephone access using a computer 'modem' to facilities such as WWW and electronic mail, often for a fixed charge per month, together with the cost of telephone calls. However, phone lines provide relatively slow access, and the power of the 'information superhighway' will only really take off when access is much faster (e.g., via a cable TV link). Cabling is currently mostly in cities where it is more cost effective, but availability is spreading all the time.

The speed of parts of the network continues to increase with the introduction of ATM (Asynchronous Transfer Mode) technology allowing an order of magnitude improvement in capacity on standard Ethernet connections used for many local area networks. However, international connections are still relatively slow. For example the publicly available bandwidth available between USA and many European countries is less than for a single Ethernet connection, as available on many local area networks within a single office building. This creates considerable network congestion, especially during US working hours.

The Internet is being increasingly commercialized. In the USA, commercial usage has already outstripped academic usage and network access for universities is no longer supported centrally by the National Science Foundation (NSF). This is likely to happen in Europe in the not too distant future.

Universities in many countries already have excellent networking facilities available for academic use which allows high bandwidth access. Museums with any university connections (or at least a university close by) would do well to foster links and use the facilities for on-line connection if this can be arranged. Often a personal contact can be the catalyst that

enables such collaboration to happen successfully. Local government is now starting to go on-line, which may be another future route for some local museums.

Museums should think about their customers when considering the provision of WWW information. Major national museums, and museums with a high proportion of US visitors, where the network revolution is several years ahead of Europe, would do well to consider connecting now if they have not already done so. The cost of communication is between two and ten times less in the US as it is around Europe. Telecommunications costs are dropping worldwide, but it is likely that the US will retain its competitive edge for the foreseeable future.

Smaller museums could well find it worthwhile going on-line when a significant number of schools gain on-line access in their area. WWW information could be invaluable for pre-trip virtual visits and orientation, the provision of on-line questionnaires and quizzes, feedback via electronic mail, etc.

Eventually most individuals in their homes will have on-line access, just as many people have a telephone or television today. However this will only happen when the networked computer is as easy to use as these appliances. Currently it is necessary to be somewhat of an enthusiast to be on-line at home. Connection speeds tend to be low via a standard domestic telephone line and costs relatively high, including an Internet provider's charge *and* standard telephone charges. When access is at video rates via the equivalent of a cable TV connection, at some reasonable fixed monthly charge, using a 'black box' which does not require significant configuration by the user, then general access will become widespread. At this point most museums will want to provide at least some information to the public on-line.

Currently the connection of a museum is often due to an enthusiastic individual who has seized the initiative, rather than being part of official museum policy dictated by the director of the museum. However this is likely to change as knowledge of the possibilities of the Internet filters through all levels of the museum world. The resources available on-line are changing and expanding extremely rapidly due to the fast expansion of the medium. Individual museums need to decide when rather than if it is worthwhile providing on-line information on their facilities and collections.

## Access to the VLmp directory

The WWW Virtual Library museums pages (VLmp) are available from any WWW client program connected to the Internet under the following 'URL' (Uniform Resource Locator):

<http://www.comlab.ox.ac.uk/archive/other/museums.html>

Please email "J.P.Bowen@reading.ac.uk" with new URLs for museums that are not yet included in this directory for possible inclusion.

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## Bibliography

- BERNERS-LEE (Tim) *et al.*: 1994, "The World-Wide Web", *Communications of the ACM*, 37, 8, pp. 76–82, August 94.
- BOWEN (Jonathan): 1995a, "The Virtual Library of Museums", in Giskin DAY ed., *Proc. Museum Collections and the Information Superhighway*, (London: Science Museum), pp. 37–39, 10 May. [URL: <http://www.nmsi.ac.uk/infosh/bowen.htm>].
- BOWEN (Jonathan): 1995b, "The World Wide Web Virtual Library of museums" *Information Services & Use*, 15, 4, pp. 317–324.
- BOWKER (Geoffrey): 1996, ed. *Computing History Web Pages Available*, (IEEE Annals of the History of Computing, 18, 1, Spring), p. 65.
- EVANS (Christopher): 1979, *The Mighty Micro: The Impact of the Computer Revolution* (London: Victor Gollancz Ltd).
- HODGES (Andrew): 1992, *Alan Turing: The Enigma* (London: Vintage, Random Century). [URL: <http://info.ox.ac.uk/~wadh0249/book.html>].
- NEGROPONTE (Nicholas): 1995, *Being Digital* (London: Hodder & Stoughton). [URL: <http://www.randomhouse.com/knopf/digital.html>].
- STRIMPEL (Oliver): 1995, "Museums On-line: Worth the Visit?", in FAHY (Anne) and SUDBURY (Wendy) eds., *Information: The Hidden Resource, Museums and the Internet, Proc. 7th International Conference of the MDA, Edinburgh, Scotland, 6–7 November* (The Museum Documentation Association), pp. 181–185.