NEW LABYRINTHS AND MAPS: THE CHALLENGE OF CYBERSPACE'S ART

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In this multidisciplinary article I explore some particular aspects of cyberspace's aesthetics. My claim is that the ancient studies of maps and labyrinths could help us to better understand and deeper interact with the complex virtual spaces of our digital era. The concept of cyberspace, usually conceived only as an informational network, sustained by computers and telecommunication technologies, must be reviewed. We must enlarge the notion and foreshadow the cyberspace as a space in which people interact, inhabit and transform themselves. The old labyrinthine wisdom tells us that the one who makes the labyrinth isn't the architect, but the walker who ventures himself inside it. The same point is fundamental in the studies of maps. A map is just a representation of a territory and we need a lot of different maps to start to glimpse a place. Besides, we should distinguish the map conceived just as an elaborated diagram of a philosophic and conceptual map. Since Deleuze e Guatarri, in *Rhizome*, map is something much more dynamic, that is always in transformation. In this sense, we should say that the conceptual map is created after a personal and subjective journey. Because, as we know from our personal experience, even when we have an excellent graphic, other geographies, other spaces emerge from our activity. The great challenge is: how could the net artists create new maps and labyrinths?

This article was born from the urge to find an answer to the following questions: can we map the cyberspace? What kinds of maps are being created? Do these maps have any use? Do they rescue their old function, which was to help the navigator? At first sight, the task of making a map of cyberspace's changing labyrinths seems very difficult. We will see many examples where cartography's target is the creation of visualizations that help the user in their locomotion within informational space. Other maps only show Web data flux. There are maps whose function is to situate the number of machines that are connected to the networks. And what about navigation? Is it possible to record it? Several projects try to represent the labyrinths created during the course; in other words, they supply us with the maps of visited sites thinking about future revisiting. Moreover, there are diagrams that map the infrastructures behind WWW, such as satellites and submarines networks. These maps, as they reveal how cyberspace actually functions, are like X Ray images of what gives structural support to the Big Web. To start our discussion about cyberspace's maps, it is necessary to first go back to the past, in search of the origins of cartography's art. We will then discuss about cyberspace's labyrinthine nature as a short introduction to these magic and complex spaces. Therefore, I invite you to follow me on a sinuous, funny and seductive route: the study of labyrinths and their maps.

An introduction to cartography

One of human oldest necessities has always been the visual representation of questions that touch deep and complex feelings. As do attest the many paintings of flocks found in caves, human beings have recorded into drawings what they consider important since the prehistoric ages. Cartography, the science and art of elaborating maps, charts and plans, is one of the oldest manifestations of culture. Some authors consider that the development

of making maps is older than the ability of writing. Among the oldest known examples, the Babylon's maps, dated of approximately 2.300 BC. On the specimen that belongs to the British Museum of London, we have on a clay tablet the representation of a river flowing out through a delta and flanked by mountains.

Through their historical development, maps have appeared on stones, papyrus, metal, skins, etc. The ancient Egyptians have created beautiful maps 4.000 years ago. We owe the true foundations of scientific cartography to the Greeks. We inherited from them: the spherical conception of the earth, the existence of the poles, the Equator line and the first system of latitude and longitude. The greatest Greek geographer was Claudius Ptolemy (AD 90 to 168), author of the classic treatise *Geographia*, a collection of several maps and a map of the world.

Figure 1: Ptolomy map.

Inexplicably, during the Roman Empire, there are no great advances in the cartographic area. In the Middle Ages, we can find wonderful maps. From this period, we have many illustrative drawings and allegories. The famous maps known as T-O come from this period. The name T-O has been given to these maps because they are composed of two circumferences, one external in the shape of an O and the other internal, divided in the middle, composing the letter T. These maps are circular, Jerusalem being their center. The T-O maps are oriented to the east: Asia is thus represented on the upper part of the T, Europe is situated to the left and Africa to the right. With the crusades and the advances of maritime commerce, the maps became more sophisticated. One of the oldest cartography's schools, created during the reign of Charles V, the Wise, in Spain, has produced the Catalan Atlas, in the year of 1375. In the 14th century, a great period for navigation, Sagres School appears in Portugal, that produces beautiful charts.

The invention of printing will revolutionize the art of mapmaking. With the printing, maps became available to a great number of people. We must keep in mind that, before this invention, it was necessary to copy maps by hand, a very laborious and sluggish work. Copied maps were first taken from wood blocks and then, from copper plates. At this time, maps were colored by hand[1].

The oldest convention adopted, the circle, belongs to the 16th century. This convention designate urban agglomerates. Until them, the medieval cartographers had been using bulwarks. When Holland becomes a commercial and naval center, in the late 16th century, we meet the figure of a famous geographer, Gerard Kramer, known as Mercator[2]. His maps are notable especially because of his creative calligraphy. Another distinguished

[1] The ancient maps were always printed on black and white. Colors only started to be used in the end of 19th century. Nevertheless, many of the maps were colored by hand. There even was the colorist trade, because of the importance of the color to the signalizing.

[2] Gerard Mercator, the father, published a chart collection – *Atlas sive cosmographicae meditations de fabrica mundi et fabricata figura* (1585-95) where we see the illustration of the titan Atlas, that mythological figure that was condemned to carry the world on his back. This image became the synonym of this kind of publication. Nowadays, there is um software developing Internet maps that is called *Mercator*.

cartographer appears in the 18th century, the German Humboldt. His main contributions were maps of distant regions, such as New Zealand and Australia. During the next centuries, cartography keeps on evolving, in search of a greater accuracy, and technological development has allowed many new processes of obtaining data.
Nowadays, maps are classified according to their destination, their subject, the level of details and the size of the represented area. We can therefore examine the following points:

1. Area
The first fact to be analyzed is the represented area. Maps are usually divided into:
1.1. Terrestrial maps
1.1.1.World Maps: make possible the visualization of the whole Earth.
1.1.2.Specific Maps: represent a delimited slice of territory.
1.2. Astronomic or Sky Maps
1.3. Marine Maps (among others)

2. Scale
Maps use different scales that are normally indicated on the bottom part of the representation.

3. Size
The size of the map in variable according to the intended purpose and level of details.

4. Purpose
This is the topic where cartography classification becomes more complex:
4.1. Topographical Charts
Topographical charts include data gathered through field research, planmetry, altimetry and aerophotography. They are extremely precise and governments mainly use them on strategies and military logistics.
4.2. Geographical Cartographies
They are created by private companies and they are available to the public in general. Their charts normally come into reduced scale; the contents are simplified and generalized.
4.3. Thematic Chart
We have here the case of the diagram, with a conceptual and informational purpose. The thematic charts represent specific facts or phenomena – political, biological, statistics, physical, etc.
They can approach concepts and subjects that are in constant and continuous transformation, as migration fluxes, forest destruction, etc. Generally, the diagrams that support the information contained on the thematic chart are extracted from the geographic cartography. They are also denominated cartograms.

A labyrinth typology

Labyrinths are images that have persisted in the history of humanity since millenniums. This long, continuous and mutant permanence unveils to us deep questions of human thought. More than the common sense is used to define; the labyrinths are signs of complexity. The greatest allure of labyrinths may reside in the fact that they are paradoxical and propose, each one in its own way, opposite and varied logics.

When one speaks about labyrinths, it is good to remember that besides human constructions, there are also natural labyrinths. Among them, the caverns and the caves that, with their narrow passages, propose us trace difficulties. The shells, exemplar image of the spiral theme, are other fecund source of daydream and reverie. The flowers, and their mandalic constructions, the leaves, the roots and the rhizomes are also natural

labyrinths. Labyrinth is present in our own body, in many of our organs such as the brain, the inner ear, and even at the fingerprint, unique sign of our identity.

The labyrinthine imaginary is present in several periods of mankind. One of the oldest graphical representations dated from the neoliptic age and is found in the cave of Valcamonia, Italy. Among antiquity's labyrinths, there are the Egyptian (totally destroyed, whose original plan was reconstructed by the English archeologist Flindres Petrie, in 1888) and the Cretan (immortalized by the mythical narratives of Theseus, Ariadne and Minotaur).[3]

The sense of labyrinth has been transformed throughout time. In the Egyptian case, we have a magnificent and majestic construction, as space dedicated to the protection of the sacred. The Egyptian labyrinth was, at the same time, sanctuary and monumental representation of the power of pharaoh and sacerdotal class.

On the other hand, the Cretan labyrinth is a prison and a shelter for the monstrous. We find this thematic in nightmares producing dark and tortuous corridors, facing a double challenge: to find the right path and kill the beast.

The labyrinths built in gardens' spaces however propose another question, and another logic. In the case of Versailles' labyrinth, for example, the idea was not to question, to puzzle or to confuse visitors.[4] The propelling purpose, that led the architect to plan garden alleys, was to provide people with fun. To emphasize this character of delight, he placed among the flowerbeds many sculptures featuring scenes of Aesop's fables.

It is therefore impossible to think of a general concept that would define the labyrinth in a single word. The classic definition of a labyrinth being such a difficult and intricate construction that the walker often loses his sense of direction and meet difficulties to reach the center, corresponds to one type of labyrinth only, and reduces the complexity involved in this theme.

Let's examine a case where the pilgrim does not have to face any doubts or question which path he should take: the labyrinths built on the ground of medieval churches, such as Chartres and Amiens cathedrals. We can say that these labyrinths do not present any problem about decision taking, as they offer one-option paths only, without any branches. Different from problematizing mazes, this kind of drawing does not present any division throughout its course. Therefore, *one-course* labyrinths do not offer the visitor any free choice. As there is no path to be chosen, there is no possibility to get lost, and the visitor only has to follow the circumvolutions, in and out, as they have been conceived by the architect. However, these beautiful diagrams had a deep spiritual meaning to the faithful. There were more than mere ornamental drawings: the novice who walked through these labyrinths while he was praying, tried to reach a supreme state of mental concentration. To walk through these labyrinths was a quest for a sacred space, a substitution to a pilgrimage to Holy Land.

According to our proposition of elaborating a labyrinthine typology, this kind of labyrinth would be the first: without any forks, also called *one-course* labyrinth.

The second type of labyrinth, maybe the most frequent in stories and legends, corresponds to a labyrinth with crossroads. I will not spend much time on this type, as the

[3] For a detailed study about these labyrinths see Leão, 1999.
[4] The Versailles Labyrinth was constructed by J. Hardouin-Mansart for Louis XIV, in the latter part of 17th century.

latter has been the object of thorough research in my previous book. We will however examine some points of interest for our current discussion. In labyrinths with crossroads, the use of schemes to pave the path, such as *Hop o' my thumb's* pebbles or a leading thread (Ariadne's thread), are extremely useful to whom does not want to become lost. However, we have to remember that many artistic works in hypermedia consider the art of getting lost as a poetic stimulus (see web art works of *Jodi*[5] and *Landsbeyond*[6]).

Cyberspace labyrinth belongs to another class, another typology. It maintains characteristics of the first kind as well as of the second kind, but it goes beyond. We are here facing a rhizome-type labyrinth. A rhizome can be connected in different directions and from each of its points - so does WWW. A rhizome does not have one center only, we have got a center in all its points. Some authors refer to the very mind as an example of rhizome-type labyrinth.

Reflections about the concept of maps

In the studies about labyrinths, the concept of maps is a quite important topic. When we think about labyrinths, different possible maps do exist. The first one, the easiest to conceive, is about the plan, the project of the labyrinth constructed at the moment of its conception. When a labyrinth is rationally thought in order to be built, it is reasonable that a map, or a project for its realization, would exist. But, as we have already seen, thousands of labyrinths have been created spontaneously and in these cases, no pre-drawn maps do, a priori, exist. A second possible category is about maps created from the discovery of a space that is being walked over. These diagrams, these travelers' maps, are registers of the wandering into the unknown, into what has been met by chance, through search and observation. We thus can start this reflection with the statement that two possible map categories may exist: the first about the ones that are created and elaborated within imagination, by a thinking mind that has got a panoramic and global view on the ground where the labyrinth is going to be realized. The second category includes a kind of map that is being created by the one who enters the labyrinth, the *penetralias*, the one who walks over an unknown space and records his/her observations.

In common sense, we usually mix up the concepts of maps and visual representation of labyrinthine space. Deleuze e Guattari (1995:22-23), in an attempt to differentiate the two concepts, gave to the representation the name *decalque*. Most of the time, the labyrinth traveler does not even know the decalque, that is to say, he has no panoramic and global vision of the whole space to be walked over. Therefore, during the wandering, he can only count on information that will be locally collected. The great challenge of this labyrinth is try to re-build mentally the walked-over space, in an attempt to extract from apparent chaos some sense of order and coherence (Leão, 1999:133). However, even when the pilgrim can count on the help of a graphic representation of space, we know that other geographies, other characteristics and peculiarities are not present in the diagram. These geographies, despite being included in the represented space, go further and multiply spaces and unfold during the walking. The fact is, beyond the represented spaces, other spaces exist and coexist, that are impossible to be reproduced in their complexity.

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[5] http://www.jodi.org

[6] www.distopia.com/LandsBeyond.html

We can thus conclude that maps, as constructions in constant metamorphosis, belong to the sphere of acquired knowledge, incorporated in lived experience. Maps, as cognitive hyperspace, is very different from fix visual diagrams /sketches, because they belong to the universe of transformations and interconnections. Maps can only be apprehended through the walking and the oscillating movements between local order and global order, going in and out, perceiving and rationalizing. Let's observe now a cope of the most recent attempts to represent and visualize cyberspace.

Maps and conventions: a glance on ancient maps

My research on cyberspace started in the early 90s. But I have always had a passion for ancient maps. What I think most charming about these maps is the reflection on how they have been conceived and created, so different from the conventions we are used to find during geography classes. It is unbelievable to think that, with the progress of naval art, courageous men would venture into unknown oceans, sometimes with the only help of hand-drawn maps, beautiful ones, however partially or totally deprived of information about where to go... On these ancient maps, it is common to find practical information, such as bays and mountains, as well as imaginary elements, such as sirens and dragons. Besides, the vast ocean spaces were often occupied by elaborated and sophisticated calligraphies. These elements seem to tell us how much the unknown could be scaring, enigmatic and a ground for the most incredible fantasies. The evolution in boat construction occurred in parallel to cartography evolution. In order to be possible to move forward to unknown territories, the already visited ones needed to be registered. Ancient maps signaling reveals this purpose and theses concerns. In cartography evolution, we can see the appearance of scales, colors, sea topographic details, mountains, hills, lakes, rivers, titles and legends, among other signaling elements.

The marking of cardinal points, for example, is fundamental for orientation. Even if we are now used to draw maps locating north in the upper part, there is no logical reason to do so. Ancient medieval maps used to put east on the top of the drawing, as homage to sacred places of the Orient. The very word *orientation* originates from this sacrosanct positioning. The procedure of using north to orient maps has been established in Italy, but, by the beginning of 19th century, examples using other orientation are still frequent (Hodgkin, 1971:9). These and other examples make us aware that our cartography, the one we are so much used to, is the result of conventions that have evolved throughout history.

One of the visions that had the strongest impact on my life has been that of the gallery of ancient maps during my visit to Vatican. The famous Vatican maps were painted at the time of Pope Gregory XII, 1572-85, in the heart of the Renaissance. The author of the paintings was Egnizio Danti, cosmographer and a Dominican friar. In the Galleries, we can see 40 maps of Italian harbors, two walls facing each other, composing the largest cycle of cartography images of Europe. According to Lucio Gambi, geographer of Milano University and author of the book *The gallery of maps in Vatican*, the series painted by Danti shows supreme geographical accuracy. Even if I was not aware of this technical information at the first moment, the observation of these maps made me thoughtful. It was as if they were in front of me the ample proof that men use conventions in order to try to represent the world in the most accurate way. Besides, the gallery of maps was an obvious demonstration of how conventions become obsolete. In spite of Danti's efforts to register in a clear way the data of the portrayed cities, his work was rambling, submerging in minor details, in stylized landscapes that did not make any sense, however beautiful they were.

I could thus look at Danti's paintings seeking aesthetic delight, as improved paintings, as pieces of sophisticated transparences**,** however, I could not grasp any sense of map, of cartography. Over the years, my attraction to ancient maps have not vanished, on the

contrary. I started to understand something more. Obviously, the Vatican maps were still disturbing me, but they were now telling me other stories. I was more controlled and calm, and therefore able to listen to their message. Although and because the sense of strangeness produced by these maps has been deafening, they teach us that our cartography conventions are not the only ones. It is maybe time for us, as we venture through the exploration of new and unknown territories such as cyberspace, to think and seek other kinds of representation, other maps.

Maps and representation of cyberspace

History

When we think in cartographing cyberspace, the great challenge seems to be: how to represent this large and changing territory, that transforms itself continuously? This challenge has been a stimulus to many people, among them, scientists, engineers, and obviously, artists.

The oldest cyberspace maps are now an important source of information and their data reveal surprising aspects of Big Web's evolution and developing. *Internet History* (1962-92)[7], timeline that shows a collection of old Net maps, is a classic reference for people who investigate historical aspects of the WWW. Other maps, curious and fundamental to the comprehension of the Internet chronological development, can be found in ARPANET[8] files.

An excellent starting point to check what has been done about this topic is the site *An atlas of Cyberspace*[9] by Martin Dodge, a researcher for the Center for Advanced Spatial Analysis - CASA -at the *University College of London*. This site shows a collection of different kinds of maps - with comments and respective links, lists of discussion and articles about the topic. Another interesting address, with maps and articles, is Omnizone[10], developed by Yu Yeon Kim and Stephen Pusey. Intending to show maps of digital culture from individual perspectives, Omnizone counted on the participation of artists, curators, scientists, programmers, etc. Many of the maps that I will comment have been found in these two sites, although others have appeared as a result of the search engines.

The research on cyberspace maps developed into three phases. I first listed all the sites and programs that aimed the visualization of the Internet. The second step included visits to the sites, downloads of software and practical experimentation. I confess that it has been a hard work, but there was no other way to find and understand these maps and their functioning. The final phase was the classification of the maps into categories, that is to explain their basic differences, regarding not only their purpose but also, and mainly, the contents to be cartographed. It is clear to me that the most important criterion for the

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[7] http://www.computerhistory.org/exhibits/internet_history/index.page

[8] http://som.csudh.edu/cis/lpress/history/arpamaps/

[9] www.cybergeography.com

[10] http://www.plexus.org/omnizone/omnizone.html

differentiation of the many cyberspace maps is the observation and the analysis of what each of them intend to represent.

A classification of cyberspace maps

1. Infrastructure maps

This category includes the representation of the structural webs that turn possible the emergence of cyberspace. They are unbelievable, splendid and surprising. Among the most fantastic ones, are maps of satellite webs and submarine communication cables. I also discovered maps of the planning for future optical fibers webs. Besides, I have to mention the *Maps of Internet Service Providers, ISP*, that show diagrams of the providers, the links between them and the users of the web.

2. Traceroutes maps

The *traceroutes* explore the directions followed by the data between the place they are filed and their arrival to their destination computer. It is quite interesting to see the paths information walks on before it reaches us. Trace routes unveil the hidden world of Internet.

2.1. NetBird [11] : this program provides us maps that originate from commands of traceroutes realized by different computers of volunteers connected to the web. These paths create a dynamic and self-organized diagram.

2.2. Skitter[12]: software em JAVA from CAIDA – Cooperative Association for Internet Data Analysis, at the Center of Super Computers of California University in San Diego. The Skitter measures and visualizes the paths followed by the data when they leave their source until they reach they many destinations. In spite of its abstract shape, it is a very useful map for the identification of critical paths, being thus a fundamental tool to web engineers.

2.3. SCAN[13] :this is another program that produces maps of the traceroutes. The Scan emphasizes the topological relationships. It addresses to big, dynamic and homogenic webs. It is a useful tool to isolate problems on traffic routes.

Figure 2: Map created by Skitter software.

Figure 3: Map generated by SCAN.

3.Websites Maps

Websites maps are quite useful and frequently used in the case of vast and complex sites. Among these maps, some have been created to help internauts' navigation on the site and others in order to help the administrator of the site and the Webmaster. Paul Jahn wrote an interesting and profound article about this topic. Some examples:

[11] http://home.sol.no/~ggunners/NetBird.html

[12] www.caida.org/Tools/Skitter

[13] www.isi.edu/scan/scan.html

3.1.Dynamics Diagrams, or *Z-diagram*,[14] : are interactive maps written in Java. They use the metaphor of files archiving and can be visualized in a projection.

3.2.Site Lens[15]: developed by the group of Research for Information visualization of Xerox, PARC. These maps indicate the main knots and the respective links of large Websites. The differential of these maps is the visual composition that reminds of the images we obtain using fisheye lens.

3.3.User Interface Research Group[16]: also from Xerox, PARC, approaches the structures and the contents of large websites from the angle of evolving ecology. Without any doubt, the research led by Ed H. Chi and Stuart K. Card is extremely revolutionary and innovating and suggest interesting paths. Their ideas can be checked in the article *Visualizing the evolution of web ecologies* [17].

Figure 4: H. Chi e Stuart Card's Maps, from User Interface Research Group.
They reveal the development of webs.

4. Surf Maps

These maps are very curious and useful, as they allow internauts visualize their paths, rescue parts of the navigated route, or even go straight to sites of direct interest.

4.1. WebMap[18] : developed by Peter Dömel in 1994, reminds of old hypertext visual diagrams. WebMap uses numbers to indicate the sequence followed in navigation. It has been presented during II WWW International Conference.

4.2. WWW Graphic History Browser[19] : created by the pair Eric Ayers and John Statsko in 1995, organizes the trajectory created throughout navigation into a conventionally structured diagram with one advantage however: the sketch is made of little rectangles that reproduce the image of the accessed pages. It has been presented during IV WWW International Conference.

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[14] http://www.dynamicdiagrams.com/

[15] http://www.inxight.com/Demos/SLS_Demos/Site_Lens_Studio_Demos.html

[16] http://www.parc.xerox.com/istl/projects/uir/default.html

[17] http://www-users.cs.umn.edu/~echi/papers/chi98/1997-09-WWW-Vizualization4.pdf

[18] http://www.tm.informatik.uni-frankfurt.de/~doemel/Papers/WWWFall94/www-fall94.html

[19] http://www.cc.gatech.edu/gvu/internet/MosaicG/MosaicG_1.0_about.html

4.3. Eastgate Web Squirre[20]: program developed by Mark Bernstein from Eastgate Systems that allows to organize visually different cyberspace sources of research such as URLs, emails, newsgroups, etc. Squirrel works with the metaphor of the *farm*. Each *farm* is a file used by the program to map informational spaces. The *farms* allow many different kinds of data structuration. The main idea is that the user keeps on filing, *cultivating* and organizing *farm* elements. Besides, the *farms*, being registers, can be shared with other users. To summarize, Squirrel is software that helps organize visually information obtained during navigation.

4.4.Internet Carthographer[21]: from *Inventix Software* company is a software that works together with the browser. It classifies and maps all visited page. The visual aspect of the map is abstract, showing different points scattered on the screen and crossing lines. At the side of the visual map, there is a summary of informative data.

4.5.Natto View[22]: by H. Shiozawa and Y. Matsushita, from University of Science and Technology of Keio, Japan, allows a three-dimensional visualization of navigation.

4.6.WebPath[23: developed] by Emmanuel Frécon and Gareth Smith from Lancaster University. It presents a three-dimensional visualization. They are complex and sophisticated maps. More information in the authors' article "WebPath - A three-dimensional Web History"[24], presented in 1998, during *IEEE Symposium on Information Visualization (InfoVis '98)* in Chapel Hill, EUA.

Figure 5: WebPath Map. It presents three-dimensional visualization.

5. Internet Visualization Maps as a whole.

5.1. Visualization Studies - NSFNET[25] - by Donna Cox and Robert Patterson, 1992. These maps use geographical metaphors and try to identify the presence of hardware connected to WWW.

Figure 6: Map by Donna Cox and Robert Patterson.

5.2.Matrix Information Directory Services[26] - MIDS - by John Quarterman, one of the first scientists to face the challenge of mapping Internet. *Matrix*, located in Austin, Texas, developed different softwares that measure, analyze and cartograph the Net. Among the maps of the web, the most recent, called Internet Weather Report[27] - IWR: it is a dynamic representation with animated maps. The mapping method is based upon the locating of web knots and applies these data to a representation of classic geography, the map of the world. In 1990, Quarterman published the book, *The Matrix: Computer Networks and Conferencing Systems Worldwide*, today a class in the discussion of problematical aspects in computer webs mapping. The title of the book, *Matrix*, in the meaning used by Quarterman, is the set of all computers interconnected webs.

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[20] http://www.eastgate.com/squirrel/Introduction.html
[21] http://www.inventix.com/
[22] http://www.mos.ics.keio.ac.jp/NattoView/
[23] http://www.comp.lancs.ac.uk/computing/users/gbs/webpath/
[24] http://www.comp.lancs.ac.uk/computing/users/gbs/webpath/webpath.html

[25] http://www.ncsa.uiuc.edu/SCMS/DigLib/text/technology/Visualization-Study-NSFNET-Cox.html
[26] http://www.mids.org/
[27] http://www.mids.org/weather/

Figure 7: MIDS Map. The use of geographical metaphor is clearly perceived.

5.3. Information visualization: research group of Bell Lucent Technologies Laboratories, Naperville, Illinois, EUA, formed by Ken Cox, Taosong He, Graham Wills, and supervision of Stephen G. Eick. This map showing three-dimensional arcs is perhaps the most famous image of what Internet is. Actually, this image is a visualization of traffic flows between 50 countries. The data of this map have been measured by backbone NSFNET, in 1993.

Figure 8: Map of fluxes in Internet, developed by Stephen G. Eick's group from Bell Laboratories.

5.4.Internet Mapping Project[28] : by Bill Cheswich e Hal Burch. The purpose of this mapping approach is to signal web data as a whole. The big difference with MIDS project is that this one does not use traditional geography. On the contrary, data maps are created into an abstract space. According to the authors article *Mapping the Internet Project*[29] their project does not use old conventions, as concepts such as places, countries and territories are challenged. The produced image reminds of the structure of a tree, showing the paths to most of the webs. The paths change throughout times. The traffic routes are reconfigured and Internet expands. The authors keep the created images and intend to realize a movie about this expansion. The algorithm of image processing is simple and currently consumes about 20 hours. In a second phase, the produced map is painted to show different data. One of theses beautiful maps was published on the coverpage of Wired magazine in December 1998. When the authors are asked about the place we are on the map, they say that this would be impossible today, because of the complexity of the portrayed web: about 100.000 knots.

Figure 9: Map produced by Internet Mapping Project.

6.Conceptual or Topographical Maps

Topographical maps are a classic in WWW and can be found not only at a macroscopic level, that is during a mapping search of the web as a whole, but also at a microscopic level, regarding the orientation of a user of a specific site.

Yahoo site' home page, although it does not visually look as a map - the way we are used to conceive it - could be considered as belonging to this category, as it organizes different Websites into topics.

Many other sites, called portals, also organize Web information into topics. Besides, it is frequent to find on the Web personal pages that display lists with indications of links.

6.1.MESH[30]: by Tim Berners-Lee, 1989. This mapping shows in hypertext WWW original propositions.

6.2.Cybermaps Landmarks[31] : a project developed by John December during the years 1994-5. The idea behind this mapping is to emphasize visually the domains of information.

[28] http://www.cs.bell-labs.com/~ches/map/db.gz
[29] http://www.cs.bell-labs.com/who/ches/map/index.html

[30] http://www.w3.org/History/1989/proposal.html

[31] http://www.december.com/web/text/cyberatlas.html

December organizes data spaces graphically, and emphasizes the connections/relationships between the subjects.

6.3.Newsmaps [32]: the proposition of the site is to collect news from different sources and organize them visually, or, as the site itself names it, to present information interactive landscapes. The visual composition is structured into topics. What is behind Newsmaps is a software system that accesses Web documents - not only news agencies but also online groups of discussion[33] - and organizes them into a sort of landscape of interconnected topics. The maps tell us where to access a big concentration of documents, messages and discussions about a specific theme. The appearance of the green maps that can be accessed on the site *Newsmaps* reminds of mountains, peaks and valleys. Peaks indicate a big concentration of documents about a specific subject. The higher the peaks, the larger the quantity of similar documents. Besides this topographical organization, the site offers tools for search, that locate a specific subject in relation to existing topics. The navigator still counts on the resource of using flags to mark the most interesting points.

Figure 10: Image of a Newsmaps information map

6.4.Web Map about teenagers' happiness[34]: map of interconnected topics, generated from an initial question and other subjects that appeared from this questioning. According to the author, cinema teacher Lee Boot, this map is a "personal and global exploration of themes that disturb adolescents". Following this line, "while incorporating personal and global thinking, some point should appear where consciousness is expanded"[35][35]. Its interface reminds of a sketched exercise book and each word designed in print letters corresponds to a link of a WWW site. The map is organized into concepts and is a mirror of the choices of the author himself and the paths he walked over on the Web. What is most interesting, in a work that looks quite simple, is that the construction of the page not only organizes the author's thinking but also allows a quick visualization of the topics and their interconnections. In Lee Boot's words:

I like to think of this website as the node, and the Internet itself as a huge morass of connections and real choices. This model echoes that of the human brain. A website is to the Internet as a neuron is to the brain. This is a form I present often in this work.[36]

Figure 11: First page of the Web Map about teenagers' happiness

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[32] www.newsmaps.com

[33] For example, on the map that presents Global News, are collected information from Associated Press, Reuters, Fox News, The Washington Post and ABC News. Another map, called *Technological News*, we can find TechWeb, PC Week, C/NET

[34] www.bcpl.net/lboot/webmap2

[35] http://www.plexus.org/WebForm/notes.html

[36] http://www.plexus.org/WebForm/notes.html

6.5.OOHAY – The object oriented hierarchical automatic yellowpage [37] : a project developed by Hsinchun Chen, director of Artificial Intelligence Laboratory of Arizona University. OOHAY belongs to the second phase of an important project regarding a Digital Library. The aim of the first phase, DLI-1, was to develop techniques to find and rescue information contained in big data banks and then to create nets of semantic connections between them. Phase 2 intends to develop techniques and methodologies for analysis and automatic visualization of large collections of documents. The method includes human classification systems and Artificial Intelligence systems. The visual effect reminds of a colorful mosaic being transformed by internauts' interaction.

6.6.Some of my favorite web sites are art[38] : this site has organized a web art exhibition, using the idea of gallery as a metaphor. It functions as a map with web artists works while it organizes and contextualizes the exhibited works. There are some curatorial texts by Rachel Baker and Alex Galloway.

Artists and maps

In this final group, we will see poetical propositions that have been developed by artists and groups of people interested in creating cyberspace visualizations. Different from the maps that we have already commented, the artistic approaches are much more free from technical concerns about data acquisition and organization. Generally, although they use technological resources, the latters must not be considered as scientific tools for the analysis of WWW structures or the functioning of the nets. Artistic maps never tell us - almost never - where we are or even the indication of the page on URL. Besides, the aim of these projects is not to help in the orientation through the sea of data. They are not precise, they are disturbing and they corrupt many of our pre-established ideas about cyberspace. The next projects that I will comment offer hidden beauties, cause a feeling of strangeness and make us incapable to answer questions, which we had never dreamed of.

WebStalker[39] is a *metabrowser* developed by British net-artists, Matthew Fuller, Simon Pope and Colin Green, from I/O/D group. WebStalker subverts one of WWW conventions that have been less questioned: the browser. As you know, the traditional browsers[40] pick up the data that are written in HTML [41] and translate the code into the shape we are used to look at. What actually happens when we load a WWW page on our computer screen using a navigator, is a translation of HTML elements. I/O/D group's work challenge this kind of translation. Realized in Director, WebStalker also allows the reading of HTML data and files. The difference is that WebStalker does not display on screen the information about these files; instead, it offers a graphical translation of the code structure.

The maps produced by WebStalker have a great aesthetic power. Each link turns into a line, each page is represented by circles. A small HTML excerpt can produce fantastic images that remind of mandalas.

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[37] http://ai.bpa.arizona.edu/go/oohayviz/index_introduction.html#publications
[38] www.alberta.com/unfamiliarart

[39] *WebStalker* is a *freeware* program. Download can be made on the site:
http://bak.spc.org/iod/iod4.html

[40] The most popular browsers are *Microsoft Internet Explorer* and *Netscape Navigator*.

[41] HTML: *Hypertext Markeup Language*, hypertext language used in Internet pages publication.

Sensorium[42], a group composed of twenty people living in Tokyo, winner of *Golden Nica* Award of the important exhibition Prix Ars Electronica[43], Linz, Austria, 1997, net category. The projects created by Sensorium are intriguing propositions for discussions about Internet and stimulate our perception. Among the most significant, we can mention Web Hopper, 1996 and BeWare ½:Satéllite, 1997. Web Hopper is a software in Java that allows the visualization of WWW internauts' trips. The map allows the visualization of the personal journey in red and the trajectory of other people, interacting within the net, in blue. The representation is dynamic and poetic. As for BeWare, it is a *live object* that reflects the conditions of the Earth from the angle of NOAA, a satellite in polar orbit, located at an altitude of 800km. The photographic images of the surface of Earth produced by NOAA are analyzed and converted into temperature data. During the exhibition of BeWare, people could touch and feel the different temperatures. The most interesting point in this sensory map is that it uses data transmission through Internet as a tool of statement. Quite in the same line as Brazilian artist Lygia Clark's sensory objects, BeWare stimulates our senses and our perception of the world.

Figure 12: Map of Web Hopper, showing internauts' movements.

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[42] http://www.Sensorium.org/all.html

[43] http://www.aec.at/