An Excerpt from *Other Networks: A Radical Technology Sourcebook* (Anthology Editions, 2025)*

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Abstract

This essay is an excerpt from *Other Networks: A Radical Technology Sourcebook* by Lori Emerson, which includes the Introduction to the volume and the chapter devoted to imaginary media. *Other Networks* begins from the premise that the internet as we know it is not a foregone conclusion: the corporatized, surveilled, and monolithic state of today's networked communications represents only one among many possible configurations. Through a taxonomy of communication systems that preexist or exist outside the internet, Emerson uncovers the promise of hidden alternatives. The excerpt includes the book's introduction and a selection of networks from this taxonomy. Its inclusion in this volume highlights *Other Networks* as one of the leading contributions to a new, politically engaged orientation in media archaeology—an approach that resonates closely with the aims and research trajectory of the *ARTCHAE* project.

Keywords: Other Networks; Imaginary Media; Imaginary Networks; Archaeology of the Internet

Abstract

Questo saggio è un estratto da *Other Networks: A Radical Technology Sourcebook* di Lori Emerson, che riunisce l'Introduzione del volume e il capitolo dedicato ai media immaginari. *Other Networks* parte dal presupposto che Internet, così come lo conosciamo, non sia l'unica possibilità: lo stato attuale delle comunicazioni in rete (corporativizzate, sorvegliate, monolitiche) rappresenta solo una delle molte configurazioni possibili. Attraverso una tassonomia di sistemi di comunicazione che precedono o esistono al di fuori di Internet, Emerson mette in luce la promessa di alternative nascoste. L'estratto comprende l'introduzione del libro e una selezione di reti tratte da questa tassonomia. La sua inclusione in questo volume riconosce *Other Networks* come uno dei contributi

* The curators are deeply grateful to Anthology Editions for granting permission to publish this excerpt from *Other Networks: A Radical Technology Sourcebook* (pp. 1–7 and pp. 178–90).

più significativi al nuovo orientamento politicamente impegnato dell'archeologia dei media—un approccio in sintonia con gli obiettivi e il percorso di ricerca del progetto *ARTCHAE*.

Parole chiave: Other Networks; Media immaginari; Reti immaginarie; Archeologia di Internet

1. Introduction

> The evolution of the means of mass communication seems to be going in two directions:
> toward hyper-concentrated systems controlled by the apparatus of state, of monopolies, of big political machines with the aim of shaping opinion and of adapting the attitudes and unconscious schemas of the population to dominant norms;
> toward miniaturized systems that create the possibility of a collective appropriation of the media, that provide real means of communication, not only the "great masses," but also to minorities, to marginalized and deviant groups of all kinds.
> On the one hand: always more centralization, conformism, oppression; on the other, the perspective of a new space of freedom, self-management, and the fulfillment of the singularities of desire.
> (Guattari 1993)[1]

> What began as a mere sensation is beginning to take form, the form of another internet. We're starting to hear the drone more clearly now, inside echoing sound effects and programs with compilation errors, far down the deep web. And we hear it from other places too. It calls to us when we water the tomato plants near the modem. We've started to notice little formations and signs in the steam from the teakettle . . . as if all around us new life forms are emerging. We notice that when we see these signs, the ordinary internet becomes difficult to use. The router blinks yellow, is interrupted or made useless by a hellish mess. Spam flows unfiltered into the inbox and videos we didn't search for start playing on the screen, like a poltergeist throwing things around inside our machines. Terese, Venke and I christen this internet the cosmic internet.
> (Hval 2020)

In 1972, after four years as publisher of the *Whole Earth Catalog*—an oversized publication also overstuffed with writeups, editorials, drawings, and straightforward information on tools, tool-making, books, and ideas relevant especially to the San Francisco Bay Area counterculture—Stewart Brand wrote a piece for *Rolling Stone* magazine detailing the surprising convergences he saw happening between computer scientists at cutting-edge research institutions like Stanford

1 In this and all other bibliographic references, the curators follow the author's choice of not providing quotations' page numbers given the purpose of including non-academic public among its readers.

University and Xerox Parc and the "computer bums" working to bring "computers to the people." As biographers are fond of saying, "it was a heady time" for both computing and the development of computer networks. Time-sharing networks,[2] which first emerged in 1961, had been around long enough that members of the counterculture (Brand's so-called "computer bums") were well on their way to launching their celebrated grassroots "Community Memory" project in 1973 (Community Memory, as well as Brand's article, are discussed in much greater depth in this book's entry on time-sharing networks). Alongside this development, the ARPANET (a packet-switched network that is almost always referred to as the progenitor of the modern day internet) had also been active since 1969; minicomputers had emerged in the mid-1960s as smaller, more affordable alternatives to mainframe computers; microcomputers, smaller and even more affordable computer kits for hobbyists, had begun appearing in 1971; and we were just a few years away from the advent of personal computers, pre-built machines for home use that featured keyboards and screens.

By the early 1980s, an international power struggle was brewing over whether and how to connect the bafflingly wide array of computers and local, national, and international computer networks, which eventually resulted in the worldwide adoption of the protocol TCP/IP: the Transfer Control Protocol/Internet Protocol, which enabled the interconnection of nearly any computer network to create the world's largest network of networks that we now call "the internet" (even when we properly mean the World Wide Web, just one of the networks on the internet). Thereafter, as networks gradually moved away from the domains of government-regulated postal, telegraph, and telephone services (PTTs) and research institutions and toward the domain of massive international conglomerates, it became next to impossible to determine where one network ended and another began—let alone where these networks were, how they worked, and how to determine the nature of our access. The "community" of Community Memory had largely been eclipsed by a kakistocracy of corporations. At the same time as this momentous shift took place from the late 1960s to the mid-1990s, the public's collective memory of what had come before this period grew increasingly blurry and ill-defined, particularly in the face of the oft-repeated stories of the internet's invention and its status as the apex of (largely American) innovation.

Now we are in 2024, and misinformation (driven by any combination of bad actors, political regimes, bots, and AI) is a daily norm, as are tracking, surveillance, and the monetization of every single click, scroll, or pause. At this moment, the internet seems to represent the very opposite of innovation, inventiveness, and progress (especially if by "progress" we mean a move toward

2 The many significant and overlapping connections between other networks, even between those that are imaginary and those that are real, are indicated by entry names and their numerical designation in the "related" field; related networks are also referenced in the description fields.

a more just and equitable society that has unencumbered access to information and knowledge). Even tech entrepreneurs seem aware we are living through a turning point—although, depending on their values and investments, opinions vary on whether today's internet is taking a turn for the worse or for the better. In December 2023, American technology executive and entrepreneur Anil Dash (arguably the Stewart Brand of the twenty-first century) penned a piece, also for *Rolling Stone*, in which he declared that, with the increasing popularity of the relatively new and noncommercial social media platform Mastodon along with the "raucous hedonism of Bluesky […] and the at-least-it's-not-LinkedIn noisiness of Threads, brought to you by Instagram, meaning Facebook, meaning Meta," the world is witnessing "the complexity and multiplicity of the weirder and more open web that's flourishing today." But, despite the potential pleasures offered by these platforms, how "weird" can they really be if they all use the same protocol and exist on the same infrastructures owned by the same multinational conglomerates?

Although I might not share Dash's enthusiasm for certain emerging social media platforms, and even though most major internet platforms are still continuing to push for the "centralization, conformism, oppression" to which Félix Guattari referred in 1993, I do think we are witnessing a concomitant shift toward what Guattari also observed: "miniaturized systems that create the possibility of a collective appropriation of the media." To me, more compelling than the small servers participating in the larger Mastodon "fediverse" are alternative networks ranging from barbed wire Fence Phones to zines and mail art [Postal System], Telefacsimile, Videophone, Telex, Microbroadcasts, Packet Radio Networks, Teletext, and Videotex—networks from the past that either still exist or are being revived. More, as I have tried to demonstrate throughout this book by including examples of experiments with or on these networks, we often don't know just how compelling a given network can be until we see *artists* exploring its limits and possibilities. (Not surprisingly, however, just as we rarely understand how networks actually work, from the moment we send to the moment we receive, we also rarely attend to the underlying workings of media art. Stories abound of how, for example, artists from the 1970s and 1980s plugged this into that which resulted in certain fascinating outputs; but details are often frustratingly lacking or altogether absent on *how* the connections took place, even when the "how" is exactly the point).

The time is ripe to build on the work already done by scholars such as Kevin Driscoll, Doron Galili, Judy Malloy, Charlton McKilwain, Cait McKinney, and Joy Lisi Rankin (to name just a handful of the most recent examples) and excavate all those networks that came before, thereby reenlivening our sense of what we would like the internet to be. And the act of excavating, of digging down to uncover how these networks worked, is key: it is not enough to merely swap stories about networks we might not have heard of before, or to marvel

at "weird" experiments undertaken with them. In defiance of the culture of exclusivity and the cultivation of an appearance of difficulty and inaccessibility that has defined telecommunications since the advent of amateur radio in the early twentieth century, this book has been written with the aim of demystifying how networks work and laying the groundwork for anyone to, say, try attaching analog telephones to barbed wire, or try picking up a soldering iron to build a super simple FM radio transmitter. *Other Networks* is written not only in the belief that another internet is possible, but that we are all capable of building our own networks.

1.1 The "Other" Networks

And just what are "other networks"? We have become so accustomed to associating networks with computer networks that it is easy to forget: networks have long been deeply heterogeneous and difficult to classify. They also have existed for nearly as long as human civilization has existed.

My initial goal was to compile an inventory of networks that preceded the internet, by which I meant any network that existed before the widespread adoption of TCP/IP. This would have been simple enough, if it weren't for the fact that the adoption of TCP/IP took over a decade (or longer) to happen, and also for the fact that (as it turns out) one may run a network on TCP/IP but not necessarily connect that network to the internet. Moreover, it also turns out that nearly countless computer networks emerged throughout the 1960s, 1970s, and 1980s—so many, in fact, that this book would need to expand to another two or three volumes to include them all. These more recent networks also present intriguing complications when it comes to classification: according to the taxonomy used in this book, they would mostly be considered "hybrid," in that they used (often undocumented, frequently proprietary) combinations of wireless and wired infrastructures, and they also often relied upon a wide range of protocols and/or software that this book's structure, biased as it is toward material infrastructure, cannot quite account for. My imperfect solution, then, has been to include only one digital computer network (time-sharing networks) as a way to gesture to all the other "other networks" that remain to be documented and to try to account for many (not all and not even most) networks that did not use TCP/IP. For the sake of ensuring my definition of 'network' isn't defined only in relation to computer networks, I understand a network as the connection between two or more nodes that facilitates human communication (thereby excluding networking technologies such as radar that are mostly used for tracking).

1.2 The Order of Things

Readers who are accustomed to reading conventional histories of technology driven by a narrative arc—a story that moves from origins through phases

of development and ends with broad acceptance—will find *Other Networks* disorienting. Why aren't networks listed chronologically? Why doesn't the year that fill-in-the-blank network was invented correspond to what appears on Wikipedia or in the *Encyclopedia Britannica*? What is this taxonomy of networks?

Throughout the process of writing this book, I learned firsthand that the idea any given thing was "invented" in a given year, in a given place, by a given person is often a convenient fiction, or a conclusion driven by the assumption that, for example, a technology does not yet exist until it has been implemented in a commercial context. I also learned that most histories of technology assume (or gloss over) a taxonomy of objects within which technologies fit. For example, we tend to believe we know what a telephone, or a radio, or a television is. Moreover, we are generally not eager to read endless stories complicating these beliefs. But what if our definitions of these technologies are driven by unsubstantiated stories about them that have been passed down for many generations? What if our sense about a given technology is based on our experience of it—perhaps our observations of what is happening on a screen—rather than on how the technology works or the nature of its underlying infrastructure? What if it turns out that there is such a thing as, for example, a Telephonic Telegraph? What if the Telephone was also originally designed for one-to-many broadcasting rather than just two-way voice conversations? What if there was and still is such a thing as Wired Radio, also known as "wired wireless"? What if Telefacsimile, Videophone, and Broadcast Television were, for some years, barely distinguishable from each other?

Thus, in the face of our increasing lack of access to or information about the material underpinnings of our telecommunications networks, I have tried to organize these other networks by their underlying infrastructure as a way to push us to think harder about: where networks are, how they work, how they are connected to each other, who owns them, and even whether we can build our own. However, while taxonomies can open up new ways of thinking about objects and their relationships to each other, they are also all, inevitably, flawed. Many times while writing *Other Networks*, I have thought of the opening pages of Michel Foucault's *The Order of Things* (1966) in which he describes Jorge Luis Borges's fictitious taxonomy of animals called the "Celestial Emporium of Benevolent Knowledge." In this wonderfully impossible taxonomy, "animals are divided into: (a) belonging to the Emperor, (b) embalmed, (c) tame, (d) sucking pigs, (e) sirens, (f) fabulous, (g) stray dogs, (h) included in the present classification, (i) frenzied, (j) innumerable, (k) drawn with a very fine camelhair brush, (1) *et cetera*, (m) having just broken the water pitcher, (n) that from a long way off look like flies." Foucault's observations about this taxonomy are relevant to *Other Networks* because he reminds us that the "exotic charm of another system of thought, is the limitation of our own, the stark impossibility of thinking *that*." Taxonomies, like networks themselves, open up some

possibilities for thinking and experiencing the world and foreclose on others. In other words, can we really adequately rethink the future of the internet as a future of networks if we don't also attempt a radical re-organization of the category "network" which we have taken for granted for too long? What's more, the monstrosity of Borges's taxonomy lies in the fact that it presents us not with utopias that "afford consolation . . . [an] untroubled region in which they are able to unfold . . . cities with vast avenues, superbly planted gardens, countries where life is easy, even though the road to them is chimerical." Instead, the utterly foreign taxonomy provides us with "heterotopias" that run counter to the comforting, smooth narratives of utopias; they "desiccate speech, stop words in their tracks, contest the very possibility of grammar at its source; they dissolve our myths and sterilize the lyricism of our sentences." While the taxonomy of *Other Networks* might not be entirely monstrous, I hope it runs counter enough to how we normally think of networks that it unsettles our sense of what we have for too long assumed to be true.

Another noteworthy oddity that emerges from classifying networks according to their underlying infrastructure is that we can see how, over time, the infrastructure, the technology, the network, the type of transmission, and sometimes even the act of communicating at a distance have all been called the same thing. No doubt the indeterminate nomenclature is just yet another illustration of how the materiality of networks has been consistently ignored or even effaced and therefore misunderstood over the past two hundred years or so. As an example of the latter, there is often little documentation about whether many of the so-called telegraphic networks in the late nineteenth century actually used telegraph wires or telephone wires, especially since "telegraph" was often used as a term to describe any kind of communication at a distance; at times, I have had to make an educated guess on whether the network was a telegraph or telephone network based on descriptions of whether the network used one wire (which implies a telegraph network), two wires (which implies a telephone network) or even a two-wire circuit (which also implies a telephone network).

1.3. The Future of the Internet Is the Future of Networks

Another way of stating the impetus behind *Other Networks* is that, while the excavation of alternative networks is important for the sake of a full historical record, it is also important for giving us tools to imagine how networks might be different. It allows us to ask "what if" questions. Insofar as it is an inventory of networks and experiments with and on those networks, this book attempts (and admittedly does not always succeed) to demonstrate the possibilities of past and present alternatives from all over the world, not just from the U.S.A., as a way to globalize and pluralize histories of the internet and to empower readers to reimagine the future of the internet as the future of networks.

Readers will note the final section of this book includes a small selection of "Imaginary Networks." And while I'm unquestionably being playful in suggesting that imaginary networks are "real" networks, I am also being serious in pointing to all the ways imaginary networks have contributed to the creation of real-life networks and have also, crucially, created parameters for what is possible. As Eric Kluitenberg pointed out in his 2006 edited volume *The Book of Imaginary Media*, "all media are partly real and partly imagined," just as all networks are both real and imagined, residing in both the present and an as-yet-unrealized future. More pointedly, Ruha Benjamin reminds us that "imagination" is not a neutral place that exists elsewhere, or to which we retreat. Instead, "imagination is a contested field of action […] a resource, a battleground, an input and output of technology and social order. In fact, we should acknowledge that most people are forced to live inside someone else's imagination and one of the things we have to come to grips with is how the nightmares that many people are forced to endure are the underside of elite fantasies about efficiency, profit, and social control." Benjamin then reminds us that racism, not unlike a technology (as we learned from Lisa Nakamura), is an axis of domination that "helps produce this fragmented imagination, misery for some, monopoly for others." One powerful alternative to this fragmented imagination is "radical imagination"—one that inspires us "to push beyond the constraints of what we think, and are told, is politically possible."

In the course of any attempt to activate radical imagination by pluralizing networks, it's clear we also need to ask hard questions: Who imagines networks for whom? Why and how does access take place? How is access to the network made difficult or impossible? Likewise, these questions need to be accompanied by pragmatic considerations: in any push to decentralize and miniaturize networks, it may not be realistic or even desirable to also push for leaving the internet altogether in favor of setting up legions of microbroadcasting stations or small mesh networks. Legacy Russell reminds us that the internet "still provides opportunity for queer propositions for new modalities of being and newly proposed worlds." The internet is still, for many, an aid to survival. I am wary, then, to suggest that *Other Networks* provides us with a blueprint to leave the internet behind altogether. Instead, I hope it opens up the possibility for choice—it is, after all, a sourcebook—a means of reawakening our sense of possibility by the excavation of networks from the past.

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2. Imaginary Networks[3]

In the opening pages of *The Book of Imaginary Media*, Eric Kluitenberg writes that "like communities, all media are partly real and partly imagined. Without either actual or imaginary characteristics, media cannot function." This book ends, then, with the invitation to explore the imaginary networks that have existed in, through, and around real networks, on a spectrum ranging from the bizarre to something just-this-side of the possible. What if networks involved the dead? Directly connected one brain to another? Used pigeons as part of a suite of internet protocols? Harnessed the quirks of quantum entanglement and produced faster-than-light communication [61]? This section uses the dystopic world of Neal Stephenson's fictional Metaverse [63] (in which the wealthy appear in higher resolution in this world's network of virtual realities) as motivation to instead pave the way for alternative networks that are part and parcel of a collectively-owned future no longer solely determined by ever-accelerating, global accumulation of capital.

[53] Necromancy
Country of Origin: present-day Egypt and Iraq (Ancient Egypt and Babylonia)
Creator(s): Unknown
Year conceived: Age of Antiquity (3000–400 BCE)
Basic Infrastructure/Materials: may include hallucinogenic plants, specially prepared rooms or altars, stones, mirrors, crystals, child or adult mediums
Related: Telepathy [56], Cosmic Internet [66]
Description: Necromancy is a type of ritual magic involving the conjuring of and/or communication with demons, angels, fairies, and (more rarely in the long history of the practice) deceased humans and nonhuman animals, in order to divine the future, answer pressing questions, or bring the dead back to life. It is, therefore, a kind of one-to-one network between the living and the dead. Necromancy was first used in ancient Egypt, Babylonia, Greece, and Rome. With the arrival of Latin translations from the Iberian Peninsula, it also experienced a revival in twelfth and thirteenth century Europe. It continues today in many parts of the world, and involves diverse techniques including inscriptions (such as the drawing of circles on the ground), signs (such as the pentagram), spells, and actions involving a wide range of objects, from swords, jugs, and candles to stones, mirrors, crystals, and so-called child mediums.
Sources: Frank Klassen (2019); Giralt (2017).

3 In this second paragraph, corresponding to the book chapter "Imaginary Networks" (pp. 178–90), each network is provided with a number in brackets, which reflects the atlas-like structure given to the volume. The networks/numbers that are mentioned here without being analyzed are fully addressed in other pages of the book [Footnote of the Curators].

Figure 1. Portrait of "Edward Kelly a magician, raising the ghost of a person lately deceased, in the church yard of Walton-le-Dale, Lancaster" from roughly 1740. Public domain.

[54] Pasilalinic-Sympathetic Compass

Country of Origin: France

Creator(s): Jacques-Toussaint Benoît

Year conceived: 1850

Basic Infrastructure/Materials: wooden beams, zinc bowls, cloth, copper-sulphate solution, glue, snails

Related: Radiotelegraphy,Telepathy [56]

Description: The pasilalinic-sympathetic compass, also referred to as "snail telegraph," was created by French occultist Jacques-Toussaint Benoît, possibly with the assistance of someone named Monsieur Biat-Chrétien (an individual whose existence

has not yet been proven), to demonstrate that snails are capable of instantaneously and wirelessly transmitting messages to each other across any distance. Benoît's theory was that in the course of mating, snails exchange so-called "sympathetic fluids" which creates a lifelong telepathic bond and also enable them to communicate with each other. He believed he could induce snails to transmit messages faster and more reliably than by wired telegraph by placing a snail on top of a letter and then prodding it with an electric charge, after which the snail would transmit the letter to another snail placed at some distance. The pasilalinic-sympathetic compass itself consisted of twenty-four different wooden structures containing a zinc bowl, cloth that had been soaked in copper sulphate, and a snail glued to the bottom of the bowl. Benoît unsuccessfully demonstrated the snail telegraph to a journalist from *La Presse*, Jules Allix, in October 1850.

Sources: *Sympathetic Snail Compass* (1851); Baring-Gold (1889); Butterworth (2011).

Figure 2. Satirical cartoon by Honoré Daumier (1869) captioned "Progrès. Les Escargots non sympathiques." ("Progress. Unsympathetic Snails.") Originally published in *Le Charivari*, September 25, 1869. Public domain.

[55] Telephonoscope
Country of Origin: U.K.
Creator(s): George du Maurier
Year conceived: 1878
Basic Infrastructure/Materials: two telephones, two camera obscuras
Related: Telephone [34], Telautograph [36], Videophone [38], Cable Television [48]
Description: On December 9, 1878, the British weekly magazine *Punch* published George Du Maurier's cartoon titled "Edison's Telephonoscope." The communication device (which was imagined as conveying two-way sound and one-way vision) was described as an "electric camera obscura." But, given that the cartoon depicted an older couple in London communicating with their daughter in the Crown colony of Ceylon (now Sri Lanka)—a daughter who is, in Doron Galili's words, "standing next to a badminton court surrounded by other colonialists and a native woman"—it's clear that the telephonoscope also represents the nineteenth century desire for a technology that could globally transmit colonialist and bourgeois ideals.
Sources: Galili (2020); Roberts (2017).

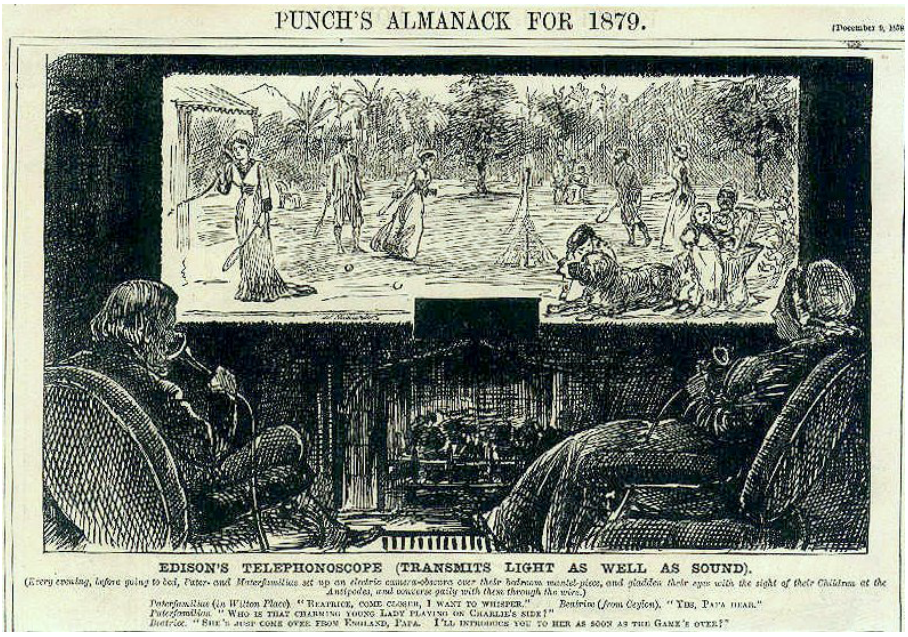


Figure 3. "Edison's Telephonoscope (Transmits Light as Well as Sound)" by George Du Maurier, published in *Punch's Almanack* for 1879. Public domain.

[56] Telepathy

Country of Origin: U.K.

Creator(s): W. F. Barrett, C. C. Massey, Rev. W. Stainton Moses, Frank Podmore, Edmund Gurney, Fredric W. H. Myers

Year conceived: 1882

Basic Infrastructure/Materials: two or more conscious and sentient beings

Related: Necromancy [53], Pasilalinic-Sympathetic Compass [54], Cosmic Internet [66]

Description: Telepathy (also known as mind reading, thought reading, and brain-to-brain communication) is the purported human and/or nonhuman animal ability to transmit information directly to another without either speech or gesture and without the use of any physical media other than body/mind. The term "telepathy" was coined by W.F. Barrett, C.C. Massey, Rev. W. Stainton Moses, Frank Podmore, Edmund Gurney, and Fredric W. H. Myers, who wrote in 1882, "… we venture to introduce the words *Telaesthesia* and *Telepathy* to cover all cases of impression received at a distance." In the late nineteenth century, various mentalists and magicians claimed telepathic abilities could be demonstrated as a result of finely honed skills for reading individuals' ideomotor and muscular movements; otherwise, nearly all attempts to prove the existence of telepathy in the twentieth century failed. In 2014, however, a team of researchers (Grau et al.) successfully demonstrated "Conscious Brain-to-Brain Communication in Humans Using Non-Invasive Technologies" (described below); some interpret this as proof of the existence of the possibility of telepathic communication.

Experiments: In 1992, Brazilian artist Mario Ramiro and Japanese artist Morio Labonete Nishimura created *Entre o Norte e o Sul* (*Between North and South*), a telepathic telecommunications experience connecting Greece and Finland using the surrounding scenery. The work consisted of an installation in each country—a wood structure in the forest next to Lake Pitäjärvi (Finland) and a stone structure on a rock formation on the island of Amorgós (Greece). As Ramiro describes it, the antennas "were made of glass tubes containing water from the Rhine River and strands of the artists' hair connected by gold leaves. Nishimura's 'antenna' was placed at the center of his piece, inside a carved lotus flower, the image he chose for his transmission to Greece. Ramiro's 'antenna' was positioned atop a large stone, upon which he drew the image of a burning sword. The artists sketched the images they 'received' and later compared the drawings, some of which resembled the intended transmission."

While they didn't set out to prove telepathy as such, an international team of researchers demonstrated successful brain-to-brain communication in 2014. Corinne Iozzio describes the process as follows: "First, the team had to establish binary-code equivalents of letters […]. Then, with EEG (electroencephalography) sensors attached to the scalp, the sender moved either his hands or feet to indicate a 1 or a 0. The code then passed to the recipient over email. On the other end, the receiver was blindfolded with a transcranial magnetic stimulation (TMS) system on his head […]. The TMS headset stimulated the recipient's brain, causing him to see quick

flashes of light. A flash was equivalent to a '1' and a blank was a '0.' From there, the code was translated back into text. It took about 70 minutes to relay the message." *Sources*: Barrett et al. (1882); Oppenheim (1985); Luckhurst (2002); Carles Grau et al. (2014); Iozzio (2014); Ramiro (1998).

[57] Ley Lines
Country of Origin: England
Creator(s): Alfred Watkins
Year conceived: 1921
Basic Infrastructure/Materials: may include any combination of prehistoric sites, ancient churches and crosses, moats and fords
Related: Cosmic Internet [66]
Description: In 1921, businessperson and amateur archaeologist Alfred Watkins hypothesized that straight lines embedded in the British landscape formed what we would today call "a network" connecting prehistoric sites, ancient churches and crosses, moats, and fords. Watkins believed that these lines were likely created in the late Neolithic period by the alignment of hilltop sighting points, and that objects on the lines were thus actually vantage and/or signaling points. He dubbed these lines "leys" in reference to the ancient Saxon word for "cleared land" and stipulated that the existence of a line is proven by the alignment of any four objects listed above "with a hill peak at one end, and with bits of old tracks and antiquarian objects on the line." While archaeologists have consistently denied the existence of ley lines, enthusiasts since the 1970s have claimed the lines form a network of earth energies. *Sources*: Watkins (1922); *Encyclopedic Dictionary of Archaeology* (2021); Netzley (2006); Charlesworth (2010).

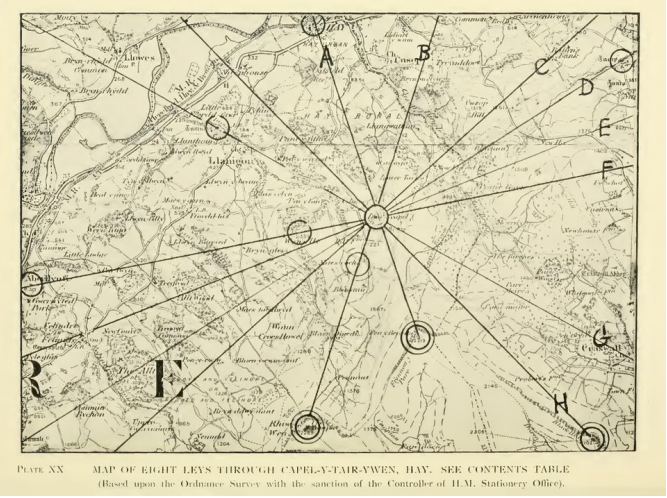


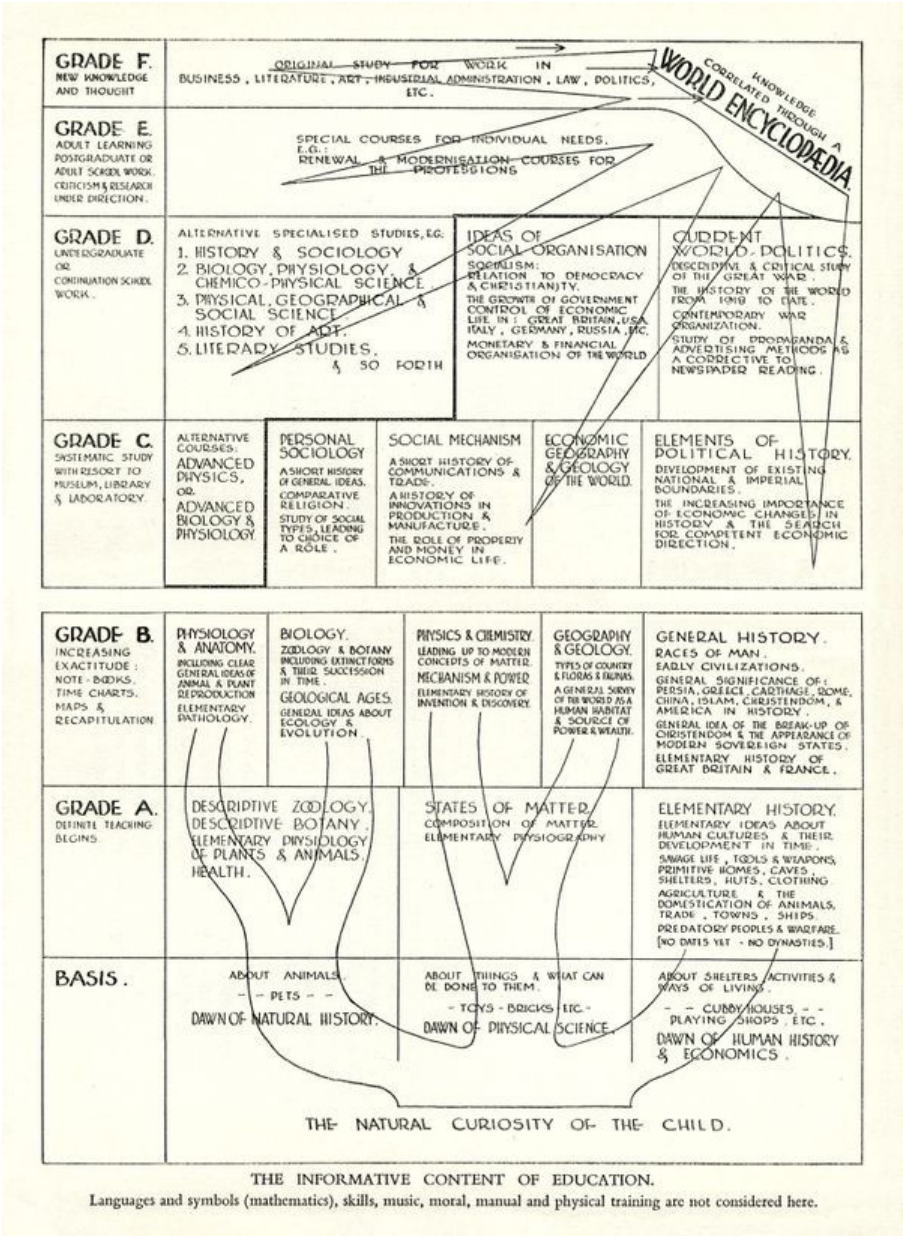
Figure 4. A map of eight ley lines in Wales, from Alfred Watkins' *Early British Trackways* (1922). Public domain.

[58] The Mundaneum
Country of Origin: Belgium
Creator(s): Paul Otlet
Year conceived: 1934
Basic Infrastructure/Materials: index cards and/or documents; filing cabinets; any combination of media including telephone, radio, microfilm, phonograph/record, television; multimedia workstation
Related: Radio Broadcast [17], book [43], Library [42], Telephone [34], Cable Television [48], World Brain [59], Memex [60], Project Xanadu [62]
Description: The Mundaneum was initially called Le Palais Mondiale and was co-conceived with Paul Otlet and Henri La Fontaine in 1910. Le Palais Mondiale took the form of numerous rooms in a government building in Brussels filled with index cards and vertical filing cabinets that provided an "encyclopedic survey of human knowledge, as an enormous intellectual warehouse of books, documents, catalogues and scientific objects." By 1934, after the project had been renamed the Mundaneum, Otlet moved on to envisioning a "réseau mondial" or worldwide network that would allow people to access information in numerous Mundaneums as well as millions of other linked documents, images, audio, and film via workstations. As Otlet describes it, the workstation "no longer carries any books. Instead there is a screen connected to a Telephone. Over there, in a great building, are all the books and related material, with all the space necessary for cataloging and registering them […]. From there one could call up a page on screen to read the answer to questions posed by telephone. The screen could be double, quadruple or [decuple] if there are multiple texts to show simultaneously; there would be an audio speaker if needed for additional material to complement the text." Each station would also allow individuals to upload files and communicate with others wirelessly.
Sources: Otlet ([1914] 1990); Wright (2014); Rayward (2013).

[59] World Brain
Country of Origin: U.K.
Creator(s): H.G. Wells
Year conceived: 1938
Basic Infrastructure/Materials: any combination of printed material, radio, photography, microfilm
Related: Book, Library, Mundaneum [58], Memex [60], Project Xanadu [62]
Description: In his 1938 collection of essays and lectures, *World Brain*, H.G. Wells describes his vision of a "new social organ, a new institution" that he calls alternately a "World Brain" or "World Encyclopaedia" that would bring together "all the scattered and ineffective mental wealth of our world into something like a common understanding, and into effective reaction upon our vulgar everyday political, social and economic life." The new organization he proposed would, he believed, prevent "transatlantic misunderstandings" by way of this "common interpretation of reality" and it would include materials from museums, art galleries, libraries, atlases, and surveys. The process of bringing together these materials and documenting them

would involve radio, photography, and especially microfilm so that "*any* student, in *any* part of the world, will be able to sit with his projector in his own study at his or her convenience to examine *any* book, *any* document, in an exact replica." The content of the World Brain itself would consist of expert-approved selections, extracts, and quotations that would, in W. Boyd Rayward's words, be "carefully collated and edited and critically presented. It would be not a miscellany, but a concentration, a clarification and a synthesis." It is often touted as an influence on the late-twentieth century World Wide Web and Wikipedia, even though both platforms have been shown to have highly unreliable methods for creating, editing, and moderating content.
Sources: Wells (1938); Rayward (1999).

[60] Memex
Country of Origin: U.S.A.
Creator(s): Vannevar Bush
Year conceived: 1945
Infrastructure/Materials: desk, screens, keyboard, buttons and levers, printed matter, microphotography
Related: Book, Library, Mundaneum [58], World Brain [59], Project Xanadu [62]
Description: In July 1945, reflecting on what lay in store for scientists in the aftermath of World War II, Vannevar Bush described his vision of the Memex: a device he had been designing since the 1930s which could solve the ever-increasing production and specialization of scientific literature by allowing individuals to make, store, and consult any piece of information in almost any medium of the time. He also made clear that the problem at the time was not necessarily technological, but rather organizational, and that the arrangement of records alphabetically or numerically does not allow the scientist to easily find the information they are seeking. Thus, the Memex mechanizes the organization of information by association—which is, for Bush, the way "the mind [already] works," "in accordance with some intricate web of trails carried by the cells of the brain." In terms of its physical design, the Memex would be a desk with screens, a keyboard, buttons and levers for creating and accessing (at variable speeds) what he called "trails" through the user's collection of books, newspapers, periodicals, photographs, etc. which in turn would be stored on microfilm. While the Memex was never built, these references to associational thinking represented in terms of webs and trails certainly influenced Theodor Nelson's notion of hypertext as well as the creation of the World Wide Web.
*Source*s: Bush (1945); Barnet (2013).



THE INFORMATIVE CONTENT OF EDUCATION.

Languages and symbols (mathematics), skills, music, moral, manual and physical training are not considered here.

Figure 5. An illustration of the pedagogical value of a "World Encyclopedia," from H.G. Wells' book *World Brain* (1938). Public domain.

[61] Faster-than-light Communication Networks
Country of Origin: U.S.A.
Creator(s): Albert Einstein
Year conceived: 1947
Basic Infrastructure/Materials: Unknown
Related: Infrared Communication, Ultraviolet Communication, Laser Communication, Visible Light Communication, Necromancy [53], Telepathy [56], Pandoran Neural Network [65], Cosmic Internet [66]
Description: Sometimes referred to as "superliminal communication," faster-than-light (FTL) communication refers to a well-trodden (even amongst physicists) but still purely hypothetical situation in which information travels faster than the speed of light. In a letter to Max Born in 1947, Albert Einstein referred to the possibility of what he called "spooky action at a distance" that could result from quantum entanglement; the latter occurs when two particles are able to share information with each other even if they are physically separate. Although Einstein dismissed the idea in the same letter to Born "because the theory cannot be reconciled with the idea that physics should represent a reality in time and space," in recent decades physicists have in fact demonstrated that "spooky action at a distance" does actually occur. The unanswered question, however, is whether *information* can also travel faster than 186,282 miles per second (the speed of light in a vacuum).
Experiments: In Ursula LeGuin's novel *Rocannon's World* (1966) she coined the term "ansible" (a contracted form of "answerable") to refer to a particular kind of FTL communication device that can send and receive messages instantaneously, even when sending/receiving across star systems. She continued to develop the device in subsequent novels such as *The Left Hand of Darkness* (1969) in which she wrote that the ansible "doesn't involve radio waves, or any form of energy. The principle it works on, the constant of simultaneity, is analogous in some ways to gravity […]. One point has to be fixed, on a planet of certain mass, but the other end is portable." Other science fiction writers such as Isaac Asimov and Vernor Vinge have adopted the terms "ultrawave" and "hyperwave" to refer to other forms of FTL communication.
Sources: Einstein (2014); Parks (2018); Popkin (2017); LeGuin (1966, 1969).

[62] Project Xanadu
Country of Origin: U.S.A.
Creator(s): Theodor H. Nelson
Year conceived: 1960
Basic Infrastructure/Materials: personal computer, screen, keyboard, Xanadu software, wired or wireless internet connection
Related: Book, Library, Mundaneum [58], World Brain [59], Memex [60]
Description: Throughout its lifetime, Project Xanadu has been variously a proposal, software, imagined online network for linked documents, and web-based demo. It is, then, in some sense only partly an imaginary network. Though implementations in Algol and Fortran existed in the early 1970s, with beta versions released in the

1980s, 1990s, and 2000s, a final version has not (yet) been released. At the heart of Project Xanadu is hypertext—an idea that Theodor Nelson came up with in 1960, coined in 1963, and wrote about in 1965. Nelson then chose "Xanadu" (named after the beautiful imagined landscape in Samuel Taylor Coleridge's poem "Kubla Khan") in 1967 to describe the project as a whole. As Belinda Barnet puts it, it should have been "like the Web, but much better: no links would ever be broken, no documents would ever be lost, and copyright and ownership would be scrupulously preserved." Certain incarnations of Xanadu involved Xanadocs (the basic document unit within the system), Xanalinks (the linking mechanism which also provided for self-repairing links), and Xanadu servers running both locally and globally.
Sources: Project Xanadu website; Nelson (1965, 1974, 1980); Barnet (2013).

[63] Metaverse
Country of Origin: U.S.A.
Creator(s): Neal Stephenson
Year conceived: 1992
Basic Infrastructure/Materials: internet, goggles, earphones
Related: n/a
Description: Neal Stephenson coined the term "metaverse" in his 1992 cyberpunk novel *Snow Crash*. Set in the twenty-first century, the metaverse Stephenson envisions in his novel is—like the contemporary metaverse that's currently being driven in part by the rebranding of Facebook as "Meta"—an internet of connected virtual spaces that users enter; but unlike the rhetoric surrounding the real world metaverse that's slowly coming into view, Stephenson explicitly positions his fictional Metaverse as a dystopic escape from an even more dystopic bleak world of global economic collapse and corporate monopolies (ironically, not unlike the actual twenty-first century world). In the novel, users access the Metaverse with goggles, earphones, and virtual avatars of themselves and, in extreme circumstances, they also experience real-world consequences (including addictions and brain damage) for their actions in the virtual world.
Sources: Stephenson (1992).

[64] The Clacks
Country of Origin: U.K.
Creator(s): Terry Pratchett
Year conceived: 1999
Basic Infrastructure/Materials: wood panels, pulleys, shutters, lamps
Related: Hydraulic Semaphore, Optical Telegraph, Signal Lamp, Pony Express, Email Letter
Description: In Terry Pratchett's fantasy novel *The Fifth Elephant* (1999), the twenty-fourth book in the Discworld series, he introduces a network of semaphore communication towers called "Clacks" that he continued to develop throughout the series. Standing at roughly three stories tall and made of wood panels, pulleys, shutters, and lamps for nighttime transmission, the towers in the network closely

resemble telegraph towers. No doubt as an echo of the Pony Express, the network was managed by the Grand Trunk Company. As the network expands across the series, it starts to incorporate technologies and terminologies from other time periods; for example, operators develop a system of punch cards to automate message transmission; in *Going Postal* (2004), Pratchett also refers to messages sent over the network as "c-mail."
Sources: Pratchett (1999, 2004).

[65] Pandoran Neural Network
Country of Origin: U.S.A.
Creator(s): James Cameron
Year conceived: 2009
Basic Infrastructure/Materials: living organisms
Related: Necromancy [53], Telepathy [56], Faster-Than-Light Communication Network [61], Cosmic Internet [66]
Description: In James Cameron's 2009 movie *Avatar*, Pandora is an exoplanetary moon on which all the flora and fauna, including the humanoid inhabitants the Na'vi, communicate through a neural network they access at certain hubs using an extension of their nervous system called a "queue." The network itself is a collection of electro chemical connections between Pandoran trees. While it is partly used by the Na'vi to domesticate certain species, it also provides access to their own memories as well as those of their ancestors.
Sources: Cameron, James. dir. 2009. *Avatar*. 20th Century Studios.

[66] Cosmic Internet
Country of Origin: Norway
Creator(s): Jenny Hval
Year conceived: 2020
Basic Infrastructure/Materials: living and/or dead organisms
Related: Necromancy [53], Pasilalinic-Sympathetic Compass [54], Telepathy [56], Ley Lines [57], Pandoran Neural Network [65]
Description: As it drifts across time periods and musings about capitalism, patriarchy, communes, witches, and the power of anger, hatred, the body, and filth, Jenny Hval's novel *Girls Against God* (2020) also dips into imagining another internet. Early in the book she describes it as a form of "intimacy through the body's waste and secretions. A self-constructed network between bodies." By the last third of the novel, the network has become "the cosmic internet"—an invisible, intangible network that exists entirely outside of capitalism and which, in fact, functions best when all connections to the actual internet are severed, a network that seems to exist in the ether, linking bodies, plants, life-forms, and even the dead. She writes, "the cosmic internet communicates through noise […]. It creates confusion, poor connections, pixelated images and digital one-way streets." And further, the two characters in the novel "agree that in the long run, when it trusts us, the web will

evolve into a fleshy peer-to-peer network, where a small part of your flesh is always seeding."
Sources: Hval (2020).

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