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AN EARLY FUTURE OF THE INTERNET

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Currently, people are speculating about the future under the heading of *digitization*, which stands for a revolution in the offing that will profoundly change societies, for example when it comes to the structure of their economy. Modern societies continually generate images and narratives, in short, *imaginaries*, of their own future, which do not so much actually say something about the future as about the self-image of society and its expectations. Such imaginaries can be found in texts from the areas of science and technology, government, and pop culture. In the sociology of technology, the term *Leitbilder* has been used for this.

In the following essay, I will discuss one important episode from the history of what was later called the Internet, in which futures of the forthcoming technology are constructed that are also revealing in regard to the problems that had to be solved at a given time. The episode was about the construction of *networked computers as communication media*.

In 1961, (D)ARPA[1] appointed J. C. R. Licklider (a psychologist who had been vice-president at Bolt Beranek and Newman since 1957) as the new head of its Command and Control Research Office, whose aim was to develop better solutions for military data acquisition (e.g., in regard to combat situations), decision-making, and internal military communications. Shortly after taking up the post, he had the office renamed the Information Processing Techniques Office (IPTO), indicating a broader research focus not confined to immediate military imperatives.

Licklider published *Man-Computer Symbiosis* in 1960. The influential essay proposes two main ways that human performance could be more effectively enhanced through cooperation with computers. Firstly, by incorporating computers into processes of *real-time thinking*, i.e., problem-solving in situations where time is critical. He illustrates this with a military example[2] and by showing that certain uses of computers do not seem to be very helpful:

> Imagine trying, for example, to direct a battle with the aid of a computer on such a schedule as this. You formulate your problem today.

1 A note on nomenclature: The Advanced Research Projects Agency (ARPA), which supports high-cost, resource-intensive research projects primarily intended for military applications, was renamed the Defense Advanced Research Projects Agency (DARPA) in 1971. It then reverted to ARPA in 1993 before switching back to DARPA in 1996. For this reason, it is referred to here as (D)ARPA. However, the network itself is referred to only as the ARPANET; at the time the network was built, (D)ARPA was called ARPA and the ARPANET is the generally accepted name for this early network.

2 Licklider does not, however, limit the utility of human-machine symbioses to military applications; see Licklider and Clark (1962, 113–114 and 115–120).

> Tomorrow you spend with a programmer. Next week the computer devotes 5 minutes to assembling your program and 47 seconds calculating the answer to your problem. You get a sheet of paper 20 feet long, full of numbers that, instead of providing the final solution, only suggest a tactic that should be explored by simulation. Obviously, the battle would be over before the second step in its planning was begun. (Licklider 1960, 5)

The second way is by optimizing *formulative thinking*, i.e., the ability to formulate complex problems more clearly and algorithmically, again with a view to making better use of time. In a *time-and-motion analysis of technical thinking* that is highly reminiscent of Taylor's and Gilbreth's workplace management studies from the late nineteenth and early twentieth centuries, Licklider reported on the results of an experiment he conducted on himself:

> Throughout the period I examined […,] my "thinking" time was devoted mainly to activities that were essentially clerical or mechanical. […] The main suggestion conveyed by the findings just described is that the operations that fill most of the time allegedly devoted to technical thinking are operations that can be performed more effectively by machines than by men. (ibid., 5–6)

Building on this finding, Licklider formulated the view that in a human-machine symbiosis, each component could contribute something different: The person would take care of the heuristic thinking and the machine would perform the algorithmic functions (see Licklider 1965, 19–20; Licklider and Clark 1962, 114).

In 1960, the main obstacle to this "anticipated symbiotic future" (Licklider 1960, 7) was the limited options for human-machine interaction. The predominant processing technique was *batch processing*, which was considered ineffective even at the time.[3] In his essay, Licklider imagined various ways in which human-machine interaction could be improved in the future, including graphic displays and voice recognition/output. If the latter were sufficiently developed, it would, he claimed, enable "real-time interaction on a truly symbiotic level" (ibid., 10–11).

Another way in which scientists sought to make the use of computers more efficient in the early 1960s was through time-sharing, whereby users at different consoles would simultaneously use a single mainframe and the processing time would be divided among them.[4] This would create a sense of *real-time* interaction between user and computer. Licklider likewise pinned his hopes on time-sharing, and imagined a futuristic scenario:

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3 On batch processing, see Ceruzzi (2000, 77–78 and 122–123).

4 On time-sharing, see Wildes and Lindgren (1986, 342–353) and Ceruzzi (2000, 154–158).

> It seems reasonable to envision, for a time 10 or 15 years hence, a "thinking-center" that will incorporate the functions of [present-day] libraries together with anticipated advances in information storage and retrieval and the symbiotic functions suggested earlier in this paper. The picture readily enlarges itself into a network of such centers, connected to one another by wide-band communication lines and to individual users by leased-wire services. (ibid., 7)

Thus, in 1960 we can already find the futurological prediction of a network that links together multiple computer centers where people work at time-sharing consoles.

These are, in rough outline, some of the ideas that Licklider had developed prior to becoming head of the Command and Control Research Office. In 1962, he composed a series of memos addressed to *Members and Affiliates of the Intergalactic Network* (i.e., the research groups associated with the IPTO): "The problem is essentially the one discussed by science fiction writers: 'how do you get communications started among totally uncorrelated 'sapient' beings?'" (Licklider 1963, n.p.) The sci-fi notion of an *Intergalactic Network* metaphorically expressed the problem the scientists were grappling with: How could the incompatibility gap between different computer systems be bridged in a way that allowed them to be interlinked and their resources made available to all users? Robert Taylor, Licklider's successor as IPTO head from 1966 to 1969,[5] recalled in a 1989 interview:

> They were just talking about a network where they could have a compatibility across these systems, and at least do some load sharing, and some program sharing, data sharing – that sort of thing. […] As soon as the timesharing system became usable, these people [different research groups] began to know one another, share a lot of information, and ask of one another, "How do I use this? Where do I find that?" […] And so, here ARPA had a number of sites by this time, each of which had its own sense of community and was digitally isolated from the other one. I saw a phrase in the Licklider memo. The phrase was in a totally different context – something that he referred to as an "intergalactic network." I asked him about this later … recently, in fact I said, "Did you have a networking of the ARPANET sort in mind when you used that phrase?" He said, "No, I was thinking about a single timesharing system that was intergalactic." (Taylor 1989, 38)

Thus, early thinking about computer networks at the IPTO was not yet premised on military requirements for a distributed network that would remain functional even if parts of it were destroyed by thermonuclear weapons. The vast time-sharing system conceived by Licklider (the *Intergalactic Network*) would have been

5 From 1962 to 1964, the post was held by Ivan Sutherland.

completely unsuited to these requirements, as it would have had a center that was vulnerable to destruction.[6]

It was not until a project meeting at the University of Michigan from the 9th to 11th of April 1967 that the IPTO swung behind the concept of a distributed network without a center. Wesley Clark suggested connecting the highly varied host computers to the network using the minicomputers that were starting to become more affordable at that time (the PDP-8 was released in 1965), which would serve as interface message processors (IMPs).[7] This shift in conception did not have an explicitly military motive, but was directly linked to the problems of compatibility that the scientists were grappling with: Very different computer systems were in use at the different universities. Any change to the network architecture and protocols would require expensive reprogramming of the systems, which put many universities off participating in the project. Clark's idea of having small IMPs as intermediaries between the host computers and the network avoided this problem. The network became, as it were, a "black box" (Abbate 1999, 52–53) for the host computers and their operators. Any changes to the network itself now only required the IMPs to be adjusted: an elegant solution to Licklider's call to facilitate communication between alien beings, and one that persuaded universities to come on board.

Notably, "the network idea existed in ARPA long before the decision to use packet-switching and was unrelated to explicitly military concerns" (O'Neill 1995, 76). The goal was to increase efficiency and share resources.[8] However, before long, resource-sharing was no longer the primary motivation for using a network, due above all to the spread of minicomputers like DEC's PDPs making access to

6 On the vulnerability of centralized networks, see Baran (1964, 1) and Roberts and Wessler (1970, 545). In other respects, I believe traces of this early model of computer networks based on the principle of time-sharing can still be found today: The term *online*, now an everyday expression, refers in Licklider and Clark's early essay to "on-line interaction between men and large-scale computers" (1962, 113).

7 See Taylor (1989, 39): "I knew that Larry [Lawrence Roberts] was leaning towards, or at least thinking about a machine in the center of the country to run the net. That worried me, and I had already told Licklider that it worried me, and he had sympathized. Then I think I had told Wes Clark, because I knew Wes had a lot of influence over Larry technically. I think I told Wes prior to us getting in his car. But I might have introduced it in the car, I can't remember. Wes, and Larry, and I, and somebody else were in this car going to the airport to go home from a Michigan meeting, and I introduced the subject, and Wes said to Larry, 'Why don't you just have a small (Wes believed in small computers) ... Why don't you have a small computer at each site to do all of this?' He laid out a scheme, and Larry eventually bought it."

8 See Marill and Roberts (1966, 426): "Within a computer network, a user of any cooperating installation would have access to programs running at other cooperating installations, even though the programs were written in different languages for different computers. *This forms the principal motivation for considering the implementation of a network*" (emphasis mine). See also Roberts and Wessler (1970, 543–544). Resource-sharing also helped to reduce costs for military institutions and research.

external mainframes less critical. Other factors came to the fore instead: Communication and the formation of communities.

In 1968, Licklider and Robert Taylor (who succeeded Licklider at the IPTO in 1969) wrote *The Computer as a Communication Device*, an essay it would be hard not to read as a *Leitbild of an Internet future* – even the editors' summary describes how Licklider and Taylor "*foresee a day* when people of similar interests will work with each other through a network of computers – even when they are in the same room" (Licklider and Taylor 1968, 21, emphasis mine). The essay came about after Licklider and Taylor visited Stanford, where Douglas Engelbart and his colleagues had conducted a series of ground-breaking studies over the course of the 1960s, culminating in the presentation of NLS in 1968.[9] This system prefigured many features of later PCs, whose development drew on the research by Engelbart and his group (as well as involving some of the same researchers): NLS had graphic displays that could be subdivided into windows (though they did *not* have what are now called *icons*), it worked with a precursor to modern-day word processing programs, used the first mouses and was one of the first systems to be connected to the ARPANET.

Licklider and Taylor projected the developments shown in the presentation and their possible implications into the future and connected them to the ARPANET, which in 1968 was still in the planning stages. They began their essay with the thesis that "in a few years, men will be able to communicate more effectively through a machine than face to face" (ibid., 21). Just as Licklider had been back in 1960, they were chiefly concerned with efficiency. But there was now a stronger emphasis on optimizing interpersonal communication than there had been in *Man-Computer Symbiosis*. To clarify how this optimization of communication using the medium of the computer was supposed to work, the authors first explained how they understood *communication*:

> When minds interact, new ideas emerge. […] Creative, interactive communication requires a plastic or moldable medium that can be modeled, a dynamic medium in which premises will flow into consequences, and above all a common medium that can be contributed to and experimented with by all. Such a medium is at hand – the programmed digital computer.[10] (ibid., 22)

In order to communicate about an object or fact, communicators must have a mental model of it.[11] The problem with these internal models is that they are not directly accessible and are at the mercy of memory's transient character. They are also colored by subjective hopes and desires. But since every social process requires cooperation, these models have to be externalized:

9 Short for o*N*-*L*ine *S*ystem.

10 Here the concept of 'medium' appears very early in connection with computers.

11 On mental models, see the contribution by Christian Schulz in this volume.

> Even such a simple externalized model as a flow diagram or an outline – because it can be seen by all the communicators – serves as a focus for discussion. It changes the nature of communication: When communicators have no such common framework, they merely make speeches *at* each other; but when they have a manipulable model before them, they utter a few words, point, sketch, nod or object. (ibid.)

Communication that leads to a (more or less) consensual outcome is the product of "cooperative modeling – cooperation in the construction, maintenance, and use of a[n external] model" (ibid., 23).[12] Licklider and Taylor illustrated this using the example of a project meeting, specifically the one organized by Engelbart at Stanford. They concluded that the possibilities already hinted at by NLS would allow external models to be generated and communicated far more easily and flexibly:

> Whether we attempt to communicate across a division of interests, or whether we engage in a cooperative effort, it is clear that we need to model faster and to greater depth. The importance of improving decision making processes – not only in government, but throughout business and the professions – is so great as to warrant every effort. […] A particular form of digital computer organization […] constitutes the dynamic, moldable medium that can revolutionize the art of modeling and that in so doing can improve the effectiveness of communication among people so much as perhaps to revolutionize that also.[13] (ibid., 25)

This revolution in communication, which for Licklider and Taylor was by no means confined to scientific, commercial, or military communication – as shown by small sketches of optimized ways to send a love letter or exchange recipes for soup (see figs 1 and 2, Licklider and Taylor 1968, 26) – depends on combining "information transmission and information processing" (ibid., 25).

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12 In their view, communication ultimately causes *convergence toward a common pattern*, i.e., convergence between the different models in the communicators' minds.

13 Interestingly, in *Man-Computer Symbiosis* Licklider wrote: "Laboratory experiments have indicated repeatedly that informal, parallel arrangements of operators, coordinating their activities through reference to a large situation display, have important advantages over the arrangement, more widely used, that locates the operators at individual consoles and attempts to correlate their actions through the agency of a computer" (1960, 10). The communication model is evidently the same as in 1968, but computer interfaces in 1960 were (as Licklider complained) so limited that any meaningful cooperation via computers seemed virtually impossible.

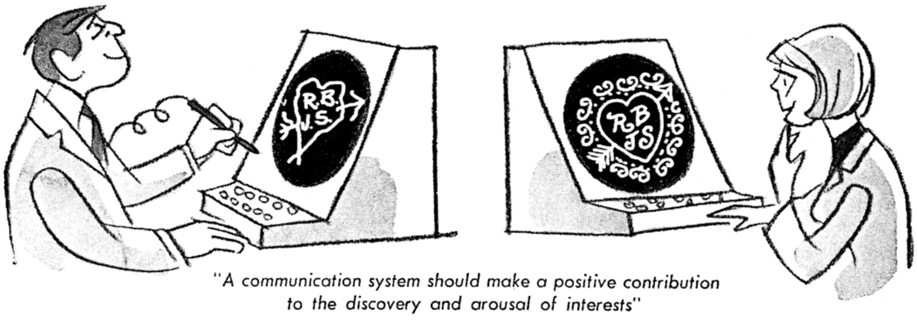

Fig. 1, Sending love letters via computer networks, from Licklider and Taylor 1968

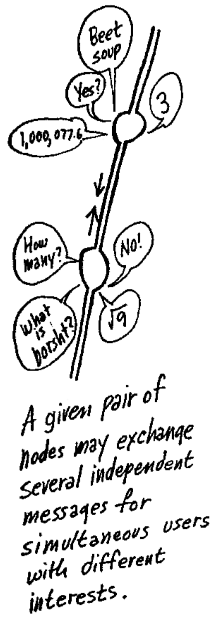

Fig. 2, Communicating about soup and mathematics via computer networks, from Licklider and Taylor 1968

The authors believed that initial steps toward this kind of optimized communication could be seen in the use of time-sharing systems. Since the essay was written in 1968, i.e., after the meeting in 1967 at the University of Michigan where the idea of a central computer to coordinate the network planned by (D)ARPA was dropped, it advocated a distributed network. The authors noted that the use of a central computer with numerous, geographically separated consoles would run into serious difficulties. The unnecessarily high telephone costs combined with very low utilization of transmission capacities was regarded as especially problematic:

> It appears that the best and quickest way to overcome them [the problems] – and to move forward the development of interactive communities of geographically separated people – is to set up an experimental network of multi-access computers. Computers would concentrate and interleave the concurrent, intermittent messages of many users and their programs so as to utilize wideband transmission channels continuously and efficiently, with marked reduction in overall cost.[14] (ibid., 26)

They then described some possibilities for a future network along these lines. These possibilities are based on the plans for the ARPANET, which the authors mentioned; they also referred to Roberts's 1965 computer networking experiment (see ibid., 28).[15] The final section of the essay, *On-line interactive communities*, is of particular interest. It opened by asking, "What will on-line interactive communities be like?" (ibid., 30) The answers Licklider and Taylor gave are so astonishing for the time they were written that they merit being quoted at length:

> They will be communities not of common location, but of *common interest*. […] In each geographical sector, the total number of users – summed over all the fields of interest – will be large enough to support extensive general-purpose information processing and storage facilities. All of these will be interconnected by telecommunications channels. The whole will constitute a labile network of networks – ever-changing in both content and configuration. (ibid., 31)

The authors describe a future network of networks – like the Internet, whose name refers precisely to its being a network made up of many networks. Licklider and Taylor's network is constantly changing and so is given the very unmilitary attribute *labile*. And they describe user communities that are held together across all geographic distances by shared interests; this idea thus predates Howard Rheingold (1993/2000), who later popularized the concept of *virtual communities*. Licklider and Taylor continued:

> An important part of each man's interaction with his on-line community will be mediated by his OLIVER. […] An OLIVER is, or will be when

14 On pp. 29–30, Licklider and Taylor discussed the economic problems in greater depth.

15 In October 1965, Roberts connected the first computers by telephone: The TX-2 at the Lincoln Laboratory in Lexington, Massachusetts, and System Development Corporation's AN/FSQ32XD1A (also known as the Q-32) in Santa Monica. Ordinary telephone lines proved to be poorly suited to this task.

> there is one, an "on-line interactive vicarious expediter and responder", a complex of computer programs and data that resides within the network and acts on behalf of its principal, taking care of many minor matters that do not require his personal attention and buffering him from the demanding world. […] At your command, your OLIVER will take notes (or refrain from taking notes) on what you do, what you read, what you buy, and where you buy it. It will know who your friends are, your mere acquaintances. It will know your value structure, who is prestigious in your eyes, for whom you will do what with what priority, and who can have access to which of your personal files. (Licklider and Taylor 1968, 31)

From today's perspective, OLIVERs are reminiscent of *agents or intelligent bots*: Semi-autonomous programs that *learn* a user's preferences so that they can retrieve information from data networks. OLIVERs are, not merely fortuitously, named after Oliver Selfridge.[16] It is also notable that in this passage Licklider and Taylor take it as a given that in the future people will be able to engage in commercial activities on data networks:

> Available within the network will be functions and services to which you subscribe on a regular basis and others that you call for when you need them. In the former group will be investment guidance, tax counseling, selective dissemination of information in your field of specialization, announcement of cultural, sport, and entertainment events that fit your interests etc. In the latter group will be dictionaries, encyclopedias, indexes, catalogues, editing programs, teaching programs, testing programs, programming systems, data bases, and – most important – communication, display, and modeling programs. (ibid., 31)

The similarity to modern incarnations of data networks is obvious. However, there are also some differences. Firstly, the authors predicted that before long people would stop using telephones, which is certainly not (yet) the case today. Secondly, Licklider and Taylor expected that at a *late date in the history of networking* all the various information available on the network would be *systematized and coherent*, which is far from the reality of today's Internet. Moreover, the extreme simplification and standardization of user interfaces, including browsers, that we know today was as yet undreamt of in 1968. So, the authors assumed that in order to navigate the network and access different sources of information (databases and so forth),

16 In 1958, Selfridge gave a lecture (Selfridge 1959) about Pandemonium, a system for simulating learning processes. This lecture marked the start of the tradition within which *agents* are situated. On Selfridge's own conception of such agents, see Smieja (1996); on agents in general, see Pflüger (1997). Selfridge also coined the term *daemons*, widely used for certain types of Unix programs.

users would need to know several computer languages.[17] They concluded on a very utopian note:

> First, life will be happier for the on-line individual because the people with whom one interacts most strongly will be selected more by commonality of interests and goals than by accidents of proximity. Second, communication will be more effective and productive and therefore more enjoyable. Third, much communication and interaction will be with programs and programmed models, which will be (a) highly responsive, (b) supplementary to one's own capabilities, rather than competitive, and (c) capable of representing progressively more complex ideas without necessarily displaying all the levels of their structure at the same time – and which will therefore be both challenging and rewarding. And fourth, there will be plenty of opportunity for everyone (who can afford a console) to find his calling, for the whole world of information, with all its fields and disciplines will be open to him – with programs ready to guide him or to help him to explore. (ibid., 31)

Licklider and Taylor concede that unequally distributed opportunities to participate in the network would further increase social discrepancies.[18] But if this problem could be successfully remedied, then Paradise could be created:

> Unemployment would disappear from the face of the earth forever, for consider the magnitude of the task of adapting the network's software to all the new generations of computers, coming closer and closer upon the heels of their predecessors until the entire population of the world is caught up in an infinite crescendo of on-line interactive debugging. (ibid.)

Licklider and Taylor see the computer, or a computer network, very emphatically as a communication medium that in the ideal-case scenario could unite the whole world into a single community and solve all economic problems: a very optimistic Internet future.

Five years after this article, an originally unforeseen application enjoyed a major breakthrough: email. In 1968, Roberts was still saying that electronic mail was "not an important motivation for a network of scientific computers" (cited in Abbate 1999, 108).[19] Ray Tomlinson modified the email program, he had developed

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17 This assumption may also have been influenced by Engelbart's presentation, as knowledge of a special, albeit relatively simple, *command language* was needed to use NLS; see Nelson (1974/1987 DM, 17).

18 Licklider and Taylor (1968, 31): "For the society, the impact will be good or bad, depending mainly on the question: Will 'to be on-line' be a privilege or a right?"

19 However, in retrospect Roberts changed his mind; see Roberts (1988, 146.)

for Bolt Beranek and Newman, and soon after the Network Working Group[20] set up email transfer in 1973 (alongside remote login and file transfer). This lead to extensive use of email (see ibid., 106–110). The network started to become a medium. Taylor said later: "It was really phenomenal to see this computer become a medium that stimulated the formation of a human community." This "sense of community" (Taylor 1989, 38) quickly began to spread among ARPANET users. Licklider and Vezza recalled later:

> It soon became obvious that the ARPANET was becoming a human-communication medium with very important advantages over normal U.S. mail and over telephone calls. […] The formality and perfection that most people expect in a typed letter did not become associated with network messages, probably the network was so much faster, so much more like the telephone. […] Among the advantages of the network message services over the telephone were the fact that one could proceed immediately to the point without having to engage in small talk first, that the message services produced a preservable record, and that the sender and the receiver did not have to be available at the same time. (1978, 1331)

However, the extensive use of the network for scientific and non-scientific communication became a source of conflict with the military… but that is another story.

It becomes obvious from this short look into the history of what was later called the Internet, that the question of the future and the construction of possible futures is an integral part of the history of this, and presumably of every, technology.[21]

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20 On this working group, set up by Roberts, see Abbate (1999, 59–60 and 66–74).

21 This essay is a short outtake of a forthcoming book on the construction of futures in the history of digital media. The project was developed during the generously funded fellowship at the Center of Advanced Internet Studies (CAIS, Bochum) during winter 2021/22.

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