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ROBOTS AND HEALTHCARE
The Deep Roots of a Technological Fix

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This essay explores the tendency to over-estimate the potential of technological solutions which are being developed to deal with the ever-increasing demand for healthcare in western countries. It proposes an explanation of this tendency in terms of a cybernetic approach to illness and medical care. It interprets this tendency as a form of what, in the 1960s, came to be called a "technological fix," and it explores the long history of such patterns of thought.

Introduction

Ever since the utopian writings of the Renaissance, such as Francis Bacon's *New Atlantis* and Tomasso Campanella's *City of the Sun*, the potential of technologies to improve human life has been a prominent theme of western thought and debate.[1] Two things are especially striking in these discussions. One is the extent to which all kinds of problems have become regarded as amenable to technological solutions —an idea more recently called the technological fix. The second is the degree to which arguments about technologies as solutions are repeated over time. In this essay I will explore this repetitive pattern by discussing debates about automation and robotics, taking as my main example applications in healthcare and focusing on the post-World War II period.

The relation between healthcare and technology, including robotics, e-health, medicines, and instruments, is especially interesting. Health is a high priority for most people, and therefore individuals and governments are prepared to spend large amounts of money on healthcare. Since the late nineteenth century a range of new technologies has been applied very successfully in fighting disease and postponing death. However, these technological innovations have sharply increased the costs of healthcare. Aging populations, who demand more care, amplify those costs to such an extent that current models of healthcare are unsustainable in the long run. Managers and politicians hope that technological innovation will increase the productivity of the healthcare sector and avert the crisis. Large investments have therefore been directed towards e-health solutions. In other words, technology is

1 Segal, *Utopias*, ch. 3.

both one of the causes, and the most hoped for solution to this looming disaster.[2] One explanation for this dilemma is the long-established pattern of expectations regarding the power of technologies to solve complicated social problems.

The main sources used in this study are a small number of popular texts about the future of robots, published between 1945 and the present, and somewhat more specialized literature on robotics, IT applications, and AI in healthcare. The essay also draws on the experiences of a high-level manager of a German health insurance company, and a community nurse in Hilversum, the Netherlands—who happen to be the author's brother and sister. The essay attempts an explanation of this particular range of technological fixes – robotics and applications of AI in health care – and their historical repetitiveness, based on the extensive literature about the history of robotics and the concept of the technological fix. But this very broad topic requires a much more systematic study than is presented here, thus this essay only offers a first exploration.

Predictions about Robots and Computers

Artificial human beings have a long lineage in the myths and artefacts of cultures around the world, from the mechanical giant Talos in ancient Greek mythology, who guarded Zeus' sweetheart Europa on the island of Crete, to the water-powered servants created by the Persian engineer Al Jazari in the Abassid empire, around 1200.[3] They testify to a fascination, in many times and places, with artificial living beings. In the West this interest deepened with the spread of the mechanical picture of the natural world, from the sixteenth century on.[4] Vaucanson's mechanical fluteplayer (1737), for example, was a serious, and impressive, attempt to reproduce the complex human activity of playing a flute.[5] After the Second World War, robotics became intimately connected with electronic computing and "artificial intelligence." A robot came to be understood as a machine that can react more or less autonomously and effectively to its environment. Thus, a robot usually has sensors, processing ability that emulates some aspects of cognition, and actuators, i.e. "limbs,"

2 This sketch summarizes a recent analysis by the Dutch Scientific Council for Government Policy: Wetenschappeljjke Raad voor het Regeringsbeleid, *Kiezen voor Houdbare Zorg, Mensen, Middelen en Maatschappelijk Draagvlak* [Opting for sustainable care: Humans, means, and legitimacy], WRR report, 10 September, 2021. www.wrr.nl/publicaties/rapporten 2021/09/15/kiezen-voor-houdbare-zorg. On technological aspects, see especially 61–72, 222–28, 251, 371–72.

3 Many overviews are available. See for example: Cohen, *Human Robots in Myth and Science*; Jordan, *Robots*; Ramunni, *Et l'homme créa le robot.*

4 Riskin, *Restless Clock*.

5 Riskin, *Restless Clock*, 118–23. This was reproduced for the Deutsches Museum's exhibit on robotics: Dittmann and Lange, "Toys, Drones, and Humanoids."

or parts that carry out the action.[6] A robot, in other words, is a cybernetic machine, whose actions resemble those of humans in that they are based on perception of the surrounding world and feedback loops; therefore they can, in principle, replace, or cooperate with people.[7] Hence, the discussion of robots is entwined with those of automation and artificial intelligence.

The introduction of digital computers immediately after the Second World War provoked an avalanche of predictions about their applications. This included robotics, because computers could, in principle, provide the processing power required for autonomous machines. In widely read books, two American experts, Norbert Wiener and George Berkeley, warned that computers would lead to a vast increase of automation of all kinds of labour, causing a massive loss of jobs. They also predicted new, more lethal forms of warfare enabled by computers: nuclear bomb design depended on fast and large-scale computing and so did guided missiles. The need to understand such far-reaching consequences of computers and other new technologies led to the emergence of "futurology," the systematic study of possible futures, which initially built on military techniques developed during the war: operations research, war games, rational choice theory, etc.[8]

A representative example of early predictions of computing is the work of the Dutch economist and government advisor Fred Polak.[9] In the 1950/60s he was a well-known writer of books and articles in which he popularized speculations about the future, mostly derived from American, German and French sources. He also advocated (unsuccessfully) the establishment of a research institute to support government decision making.[10] Polak believed, following especially Norbert Wiener, that computers and automation would bring about the most radical transformation the world had ever seen, a "second industrial revolution." Although computers were

6 George Bekey, cited by Jordan, *Robots*, 27. Frank Dittmann has documented the wide popularity of robots in the 1920s and 1930s, including the idea of thinking machines: Dittmann, "Golem, Homunculus und Robot."

7 Royakkers et al., *Overal Robots*, 15–19.

8 Seefried, *Zukünfte*, chapter 2.1.

9 My main source is Polak, *De nieuwe wereld der automatie*. The first 175 pages of this book were identical to his earlier book *Automatie. Industriële en culturele revolutie*.(1958), which was based on articles and lectures he had given from the mid-1950s on.

10 On Fred Polak see especially De Vries, *Complexe consensus*, 149–67; Van der Helm, "The future." For Polak's earlier thinking, see Polak, *De Wentelgang der Wetenschap*. His later, more optimistic views can be found in Polak and Van Loon, *Gesprek met Morgen*. Although Polak usually did not mention his sources, one must have been Jungk's *Die Zukunft hat schon begonnen* (1951), which appeared in Dutch translation in 1953, was reprinted five times during the 1950s, and was well received in the Dutch press. See, for example, *De Tijd*, 20 November 1953, and *De Telegraaf*, 13 November 1953. Jungk's arguments and style of reasoning were similar to Polak's; the title, for example, assumes the same inexorable development.

basically calculating machines, they could process all kinds of information and make informed rational decisions. This meant that they could replace at least some human brain work, just as earlier machines had replaced human muscle power.

Later—in the 1960s, Polak predicted these machines would be capable of learning and reproducing themselves, which would make them increasingly independent of, and superior to, humans.[11] These changes would lead to a massive loss of jobs in factory work, but also in offices and the service sector. Not only low-skilled jobs would be eliminated. Lawyers and doctors, for example, whose work consisted basically of analysing data, would also be replaced. Because computers could handle much more data, and more quickly, their judicial decisions and medical diagnoses would be more accurate and effective than those made by human experts. Computers would operate machines in factories, but would also perform surgery. And he made other claims which from today's point of view seem prescient. He predicted that there would be self-piloted (driverless) cars and ships—just as there were airplanes with auto-pilot already. In business, machines would make quick predictions of the stock market and calculate the demand for certain products, which enabled them to make decisions that were now taken more slowly and more haphazardly by expensive managers. In personal life, computers could choose a person's marriage partner; decide which political party most fitted one's preferences; and select the candidate most qualified for a job. They would be able to analyse and manipulate the most intimate human feelings and desires, because their analysis would be objective, untroubled by human feelings.[12] For this reason too, they could make precise predictions about the form and content of entertainment that would please a large audience.

Polak predicted that computers would become ever smaller and cheaper (as had happened with other electronic devices, such as transistor radios). Everyone would have one on his or her desk. Computers would become connected in a network, which enabled people to retrieve information of all kinds and to communicate all over the world.

In his early writings, during the 1950s, Polak projected a very gloomy picture of the automated future. He expected massive unemployment, especially for people with lower education levels. Power would shift towards a small group of highly educated technocrats. Labour unions would decline.[13] Unemployment was a big problem, because work is essential for people's well-being—for feeling useful, having a role in the community. Thus much unhappiness, perhaps protest, and possibly even social chaos and political radicalism would ensue—as had happened in the 1930s. Loss of income would cause an economic slump. More vaguely expressed, but

11 Polak, *Nieuwe wereld*, 120, 127, 134; most of his predictions can be found 135–74.

12 Polak, *Nieuwe wereld*, 144–46.

13 Polak, *Nieuwe wereld*, 95–99.

perhaps most threatening, was the prospect of a kind of generalized mechanization and dehumanization of society—an idea rather common in western societies.[14]

What did Polak propose to do? Rejecting automation and computers was not an option: this would lead to economic stagnation by staying behind other countries that did introduce these innovations. Instead, Polak proposed introducing a basic income for everyone, so that people would continue to buy things and keep the economy going. In addition, he argued that work that was unpaid, often considered unproductive, but actually very valuable, such as caring for the sick and elderly, should have a higher status. Education should be expanded, so that people would use their leisure time for intellectual and artistic pursuits.

Polak's style of reasoning consisted of a mixture of apodictic, deterministic prediction and political recommendations, in uneasy balance. On the one hand, he argued that technological progress was due to an unstoppable human drive to dominate nature, which would culminate in the creation of a perfect artificial human being.[15] Having no technical experience, he ignored technological limitations, always projecting the future from what appeared to be possible. On the other hand, he believed that government could, and should, correct this development.[16] It was an obvious rhetorical ploy: by emphasizing the urgency of the problem, he underlined the necessity of action, and supported his personal application for the job of national super-manager. None of this was very original: authors such as Robert Jungk, Peter Drucker and Friedrich Pollock also wrote of automation as the wave of the future, and, like Polak, saw the United States as leading the way.[17]

In 2014, sixty years after Polak issued his predictions and recommendations, two American professors of management at the Massachusetts Institute of Technology, Erik Brynjolfsson and Andrew McAfee, published *The Second Machine Age*, a work that contributed much to a new wave of excitement about robots.[18] The content and tone of this book are surprisingly similar to Polak's. The title echoes Norbert Wiener's "second industrial revolution," which Polak also used as a key term, and the same excitement pervades the book: we are entering an entirely new age. Why? Because machines now can think: "they aren't just number crunchers, they're symbol processors"—an idea at least 60 years old, presented as a new and very exciting discovery.

14 For more on this topic: Abnet, "Americanizing the Robot."

15 Polak, *Nieuwe wereld*, 71, 125, 132–34, 205.

16 Polak, *Nieuwe wereld*, 108.

17 Jungk, *Die Zukunft Hat Schon Begonnen*, 13, 14, 232–33. For Drucker and Pollock, see Radkau, *Geschichte der Zukunft*, 100–4.

18 Brynjolfsson and McAfee, *Second Machine Age*.

Many changes that Brynjolfsson and McAfee believe will be brought about by intelligent machines are very familiar to those who have read Polak and Jungk. They too talk about driverless cars and automated medical diagnoses, for example: all kinds of work that require a combination of sense perception, decision making, and physical work will be impacted by automatic machinery. Brynjolfsson and McAfee are much more optimistic however: they believe that these changes will bring human progress. The problems that will inevitably arise are also similar to those signalled by Polak: massive unemployment, which is bad because work gives meaning to people's lives, and a shrinking of markets when people lose their jobs and income. Like Polak, they accept these changes, albeit more happily, and then propose similar policies: expanding education to help people find new jobs, making work in human care paid—or better paid, and using tax money to direct the economy in a more sustainable direction, for example by expanding public transport.

Brynjolfsson and McAfee do not only repeat old arguments. Many of the innovations they talk about were predicted, in more general terms, by Polak and the futurists of the 1950s, but in the meantime have been realized or have become a more immediate prospect. For example, they talk a lot about the possibilities of computer networks, which Polak only speculated about in his later publications, during the 1960s. Brynjolfsson and McAfee consider, but reject, universal basic income, proposing a "negative income tax" instead, which will give people income security without eliminating the incentive to find work.[19]

Similar predictions can also be found in Israeli historian Yuval Harari's books about the long-term course of history, and the future we may expect.[20] Harari too talks of the replacement of human work on a huge scale, the weakening of labour unions,[21] and of the possible manipulation of human thought and feelings ("humans can be hacked").[22] Human beings, Harari believes, are essentially machines.[23] When talking about an appropriate response to the coming of robots, he advocates accepting AI and automation for their advantages, introducing universal basic income, improving and innovating education (for the young will have to deal with an entirely new world, dominated by AI), and increasing the appreciation of crucial, but unpaid activities that cannot be automated, such as child rearing.[24]

In *The Shock of the Old*, David Edgerton has argued that technological predictions tend to be repeated over and over again: "History reveals that techno-

19 Brynjolfsson and McAfee, *Second Machine Age*, ch. 14.

20 Harari, *Sapiens*; Harari, *Homo Deus*; Harari, *21 Lessons*; I use mainly the latter book. For an overall assessment: Nye, "Harari's World History."

21 Harari, *21 Lessons*, ch. 2, esp 42.

22 Harari, *21 Lessons*, 37.

23 Harari, *21 lessons*, 30–35.

24 Harari, *21 Lessons*, 49–50.

logical futurism is largely unchanging over time. Present visions of the future present a startling, unselfconscious lack of originality." Among the many examples he mentions is the telegraph, which was greeted with a rhetoric very similar to that about the early internet more than a hundred years later: it would bring humanity together, make national boundaries less relevant, create mutual understanding among nations, eliminate war. Critics worried that it might also lead to information overload and nervousness. Claims about the increasing irrelevance of national borders and the coming of world peace in light of the telegraph have also been made for airplanes, radio, and movies.[25]

As to worries about automation, most of these were anticipated in debates about the consequences of the mechanization of industry in nineteenth century England.[26] Mass unemployment and a collapse of the market were predicted. Thomas Carlyle, in his famous essay "Signs of the Times" (1829), predicted the dire spiritual consequences of mechanization.[27] He called his time the "Age of Machinery, in every outward and inward sense of that word." The core goals of this new type of society, he wrote, were "expediency and utility," to be achieved by "adapting means to ends," employing measurement and calculation.[28] The social form of mechanization was "organization," which he opposed to dynamics: "the primary, unmodified forces and energies of man, the mysterious springs of Love, and Fear, and Wonder, of Enthusiasm, Poetry, Religion, all which have a truly vital and *infinite* character."[29] Mechanics and organization were clearly on the rise: "Men have grown mechanical in head and heart, as well as in hand. They have lost faith in individual endeavor, and in natural force, of any kind." They don't trust "internal perfection," but only "external combinations and arrangements, . . . institutions, constitutions, . . . Mechanism of one sort or other."[30] Mechanics and organization have always been important parts of men's practical lives, says Carlyle, but never the dominant ones, and they are not "the chief source of his worth or happiness."[31] While mechanics quantifies, dynamics is about things that are too complicated to quantify.[32]

25 Edgerton, *Shock of the Old*, xvi, 113–14. Compare Czitrom, *Media and the American Mind*, chapter 1, about expectations of the electric telegraph. The parallels with recent discourse about the internet (only on the horizon when Czitrom was writing) are striking. Also Supp–Montgomery, *When the Medium.* For early American expectations of airplanes: Corn, *Winged Gospel*.

26 Berg, *Machinery Question*.

27 Carlyle, "Signs of the Times."

28 Carlyle, "Signs of the Times," 64, 73, 79.

29 Carlyle, "Signs of the Times," 72.

30 Carlyle, "Signs of the Times," 67.

31 Carlyle, "Signs of the Times," 73.

32 Carlyle, "Signs of the Times," 73.

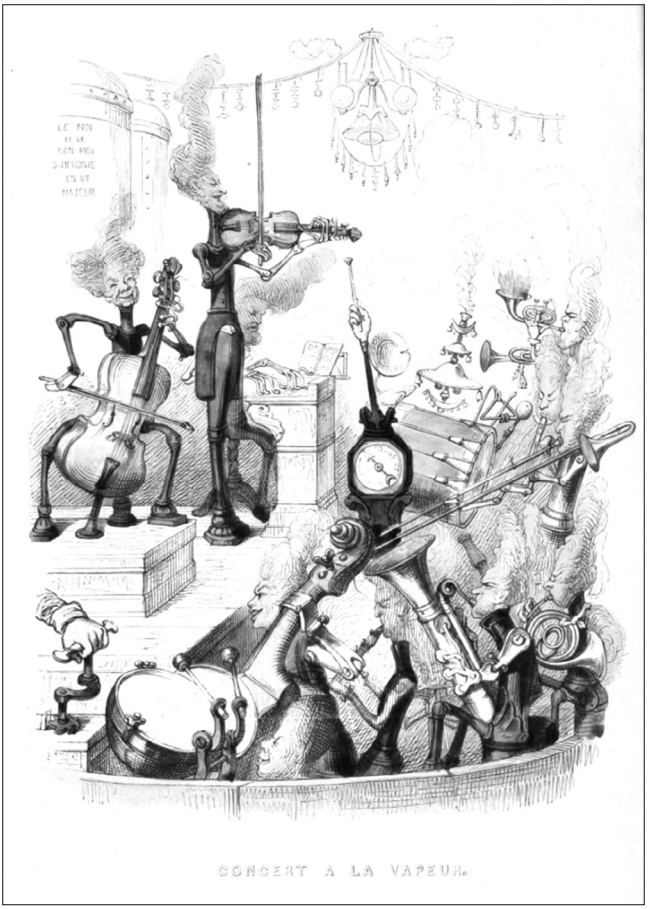

Figure 1. This cartoon by Grandville, dating from 1843, shows how steam will change even those things we don't associate with machines. It also suggests that newly powerful machines will be able to replace humans in very human types of work. (Source: "Steam Orchestra," *Illustrirte Zeitung*, 1843.)

Predicting the Future of Healthcare Care

The field of healthcare is particularly interesting for our topic because care is commonly associated with human warmth, empathy, the spontaneous human impulse to help and the desire to be helped. These qualities don't harmonize easily with the common understanding of technology as an efficient means to achieve well-defined ends, with measurement and calculation as instruments. It evokes the nightmare of care deprived of its soul, of "dynamics" displaced by "mechanism," in Carlyle's terms.

Today, the use of robots and other digital devices is commonly framed as a necessary response to the rapidly increasing need for healthcare in an aging population. In the Netherlands it is estimated that by 2040, about one quarter of the population will be over sixty-five years old, and about one in three working people will need to be employed in the healthcare sector.[33] By 2060, costs will have tripled to about 23 per cent of the GNP.[34] Technological solutions are sought to lessen the strain on the workforce and the demand on public funding.[35] The main objective is to reduce the number of appointments at doctor's offices, the demand for nurses' visits, and the amount of time spent in hospitals. One way to achieve this is by monitoring patients at home, for example by having them do blood and urine tests and measure blood pressure, pulse, weight, blood sugar level, and whatever other relevant data may (and in the future can) be measured. These data are sent electronically to a health centre, which analyses them by means of advanced algorithms. The outcome determines whether a video-consultation with a doctor, a physical visit to a doctor, or some other medical intervention is needed. This procedure is expected to considerably reduce the amount of contact with health workers, by moving some of the workload (doing tests, sending and handling the data) from doctors to assistants and to the patients themselves, which is much cheaper. In addition to relieving the pressure on health services and budgets, these advances are claimed to improve the quality of healthcare. Expert systems provide access to the latest knowledge about diseases and remedies, and algorithms can process huge amounts of data. Individual doctors, who must rely on their training and limited expertise, cannot hope to compete with this. And last not least, these services can be made available even in remote places, where there are no hospitals or doctor's practices.[36]

Robots can also be deployed to improve healthcare and help carers. Some care can also be given at home, for example by a robot that provides the patient with timely doses of medicine, reminds her of appointments, opens and closes curtains, assists her in going to the bathroom, demonstrates physical exercises, and calls for

33 Royakkers, *Overal Robots*, 75; Wetenschappeljjke Raad voor het Regeringsbeleid, *Kiezen*, 44–45, 251; Evert-Jan van Lente, "Wie Digitale Technik das Gesundheitswesen Verändert" [How digital technology changes the health care system]. Manuscript, 25 November 2017.

34 Wetenschappeljjke Raad voor het Regeringsbeleid, *Kiezen*, 79.

35 A large proportion of public health budgets are consumed by administration, excessive prices of medicines which hardly yield better results than cheaper ones, and unnecessary tests and treatments. Corporate interests and power often run counter to the public interest. Ezekiel Emanuel, quoted elsewhere in this article, is among the best analysts of this topic for the American situation. For the Netherlands, see the report of the Wetenschappeljjke Raad voor het Regeringsbeleid, *Kiezen*.

36 Also Harari, *21 lessons*, 63.

aid when she falls. Demented patients can get a humanoid robot to talk to and get responses from, sparing nurses and family the boredom of endlessly answering the same question. Robots are being developed that can help nurses to lift patients or help patients to sit and stand up. And so on. All of this is supposed to both increase the autonomy of patients, by allowing them to stay at home, and lighten the burden of nursing.

In the new system, manufacturers of e-health equipment may anticipate booming business, and governments are promised considerable cost reductions in healthcare.[37] Most authors describe these developments as logical and necessary responses to current needs, as well as having signal advantages, and then proceed to discuss the obstacles on this obvious road: the resistance of doctors and apothecaries who see their roles and income threatened, the reluctance of industry to invest in technologies that require extensive testing before being accepted for use by insurance companies, and the dead weight of established procedures and government bureaucracy.

Accompanying this, there is a lively ethical discussion too. The core of the ethics discourse is the question what it means to care for another person. If care is defined as a human relationship, technology can only be a tool, an auxiliary, not a replacement. Some argue that by taking over routine tasks, robots will create room for more interaction between patients and their nurses and doctors. Pessimists fear that the main goal of replacing human labour by machines is to make healthcare cheaper and less dependent on human frailty and unpredictability. They fear (or already observe) healthcare workers interacting more with their screens than with their patients.

Just as is the case in the general literature, from Polak on, the language of these predictions is often that of excited expectation: robots and other intelligent devices will revolutionize healthcare. This revolution cannot be stopped—essentially because machines work more perfectly than humans do—and because there are not enough people to do the work needed. Hindrances and ethical questions are mentioned, but not allowed to obstruct the general enthusiasm.[38]

37 While the Rathenau Institute's *Overal Robots* clearly reflects these positive expectations, the recent report by the Wetenschappeljke Raad voor het Regeringsbeleid, *Kiezen* emphasizes that despite much investment, e-health so far has not lowered costs much, nor has it led to important efficiency gains in healthcare provision; yet further developing of e-health is necessary, the report says.

38 For example: "new medical technologies will be an increasing part of daily life" (Royakkers, *Overal Robots*, 76); "Die Digitalisierung wird die Art und Weise wie jetzt Prävention, Diagnostik und Therapie betrieben wird, völlig umkrempeln" (Van Lente, "Wie digitale Technik," 1).

The Cybernetic Ideal

Not all the devices mentioned in the previous section can be called robots. For example, whether a lifting robot is more than a "people crane" depends on whether it responds effectively to the weight, or signs of discomfort, of the patient it is lifting, and the degree to which it can operate unassisted—such robots are being developed, but none are in use so far. However, the development of healthcare can be understood as approaching a cybernetic model, in which robots (whether or not resembling human beings) are core elements.[39]

In this model of health care, maintaining and restoring health are carried out by means of feedback mechanisms. Human beings are conceived of as essentially machines, the functioning of whose parts (blood, heart, lungs, etc.) is measured. The resulting data are fed into the larger machine, the healthcare system, which provides reactions to the measurement results. This response includes diagnosis and medical treatment if the measurement results deviate from the norm. After treatment, the system again evaluates measurements and gives further recommendations, with the aim of restoring the values to (what are defined as) normal levels, or at least approximate them.[40] Constant improvement of this basic idea is the core of e-health predictions.[41] This model has proven itself, in many cases, to be effective, and although this essay will critically examine it below, I reject the cheap criticism that this system represents a heartless approach to human suffering: doctors and nurses operating the system are generally competent, friendly and helpful, working hard to improve the wellbeing of their patients.

Limits of the Cybernetic Model

There are three main problems with this model of healthcare. First, healthcare consists of work too various and complicated to be fitted into computer programs and carried out by mechanical means. This is true even of work that humans do

39 This rather obvious analysis of the healthcare system in terms of cybernetics reflects the fact that cybernetics articulated the much older and very influential mechanistic approach to the world, going back to Descartes, as will be explained later. That is why cybernetic approaches survived the decline of cybernetics as a new meta-science from the 1960s on, and why it still frames much thinking about social and medical problems. (Kline, *The Cybernetics Moment*, chs. 7, 8 and 9.)

40 Modern greenhouses, which provide our vegetables, are basically similar cybernetic systems.

41 For an excellent discussion of the possibilities and limits of "learning systems" in healthcare, see Zahn, "Lernende Maschinen." (thanks to my brother for this reference). On artificial intelligence in general there is a flood of literature. A good overview of basic issues is the long introduction in Franchi and Güzeldere, *Mechanical Bodies,* 1–149.

routinely and easily. For example, robots can calculate incredibly fast and defeat the human world chess champion, but they have great trouble folding towels—just imagine how difficult it would be for one to replace a patient's bandage (this is known as Moravec's paradox). Robots that move around work well in simple and well-ordered environments, such as factories and hospitals, but hardly in the relative messiness of private homes.[42] If such automatic devices are not thoroughly tested in the environments in which they are supposed to work, and with real nurses and patients, unforeseen problems always arise, with the effect that clients and nurses are more busy making them work than receiving support from them.[43] Managers and politicians put pressure on healthcare organizations and their employees to introduce digital applications, because they believe this gives these managers more control over the system. Healthcare workers often resist these new technologies, not out of conservatism, but because of these frustrating experiences.

Second, even more complicated than healthcare are living bodies, of which our understanding is very limited. This is especially true of the relation between consciousness and the body. While all mental activity is accompanied by physical changes, not all mental activity can be *explained* by physical processes; thought and feeling require a nervous system, but cannot be completely explained by it.[44] Indeed, psychotherapy usually involves some kind of human interaction in addition to medication. The enigmatic relation between body and consciousness also appears to be crucial in health and disease. It explains, to some extent, the numerous cases of unexplained cures, attributable to changes in a person's life. It suggests why therapies that are entirely outside the bounds of regular medicine and even considered quackery seem to work. True, most of this evidence is anecdotal (but can, perhaps,

42 Robertson, *Robo Sapiens*, 181–82.

43 My sister gave me many examples from her practice. Medicine dispensers work fine, for example, until the manufacturer delivers them in a different package which does not fit into the machine. David Noble has documented such problems in industry (*Forces of Production*, 62, 183–87, 333–50), and David Gugerli gives examples from the administration of large organizations (*Wie die Welt*, 122–35). Current examples of robots in healthcare: "Zorginnovaties," ZorgVanNu, accessed July 2021, https://www.zorg vannu.nl/oplossingen/overzicht/trefwoorden/robot; "Robotics in Nursing," Duquesne University School of Nursing, updated 22 May 2020, https://onlinenursing.duq.edu/ blog/robotics-in-nursing/.

44 The philosopher Stuart Hampshire has called the relation between mind and body one of the two great mysteries in the history of human thought—the other one being "the nature of mathematical knowledge" (*New York Review of Books*, 24 Oct 2004), and Noam Chomsky has said the same thing about consciousness. See Dennett, *From Bacteria to Bach*, 373. There is an immense literature about the mind-body relationship. Lucid brief accounts of the problem can be found in two reviews by Colin McGinn in the *New York Review of Books*, about books by computer scientist Ray Kurzweil, and by the French neuroscientist Jean-Pierre Changeux, respectively (21 March 2013 and 11 July 2013).

be scrutinized more systematically), but it occurs too frequently to ignore. As one homeopath said in a seminar, when asked how he dealt with a patient's overweight, "oh, I don't pay much attention to that. As soon as the remedy makes him feel better, we will see his weight go down."[45] One implication is that complementary (non-regular) therapies, if they appear to work, should be approached with an open mind. This does not imply accepting their underlying theories of human life, but simply admitting the limits of our understanding and appreciating that some therapies work for some people, whether or not we understand *how* they work. An additional reason for taking complementary therapies more seriously is that they are massively cheaper than regular medicine, and don't entail painful testing on animals. This does not make them beloved of Big Pharma, but might appeal to governments and insurance companies.

The third critical limitation of the cybernetic approach to healthcare is that machines, unlike humans and animals, do not suffer and die: in principle, they can live forever. Mending them is a matter of replacing worn out or dysfunctional parts. Thus if dealing with suffering and death is a core element of healthcare, the cybernetic approach does not take us far.[46] The training of doctors and nurses includes, in the Netherlands at least, instruction in the best manner to deal with patients with complex, prolonged conditions, who often cannot be cured, but only provided some relief from suffering ("palliative care"). Many doctors and nurses complain, however, that they are insufficiently prepared for dealing with such patients. The focus of regular medicine is squarely upon healing, not on dealing with the impermanence of life. There is a financial side to this too. Hospitals with a too high rate of mortality get a bad reputation. Similarly, doctors' reputations are served more by curing than by caring for dying people.

All the same, technical, standardized procedures have a definite appeal to doctors and nurses too. Healthcare workers often feel helpless when they cannot relieve suffering. One way to deal with that anxiety is to stick to protocols. Monitoring and standard interventions provide a sense of security, a feeling that one is doing what is proper. Standard procedures create technical continuity in the face of personal discontinuity: nurses often work part-time, and when on the job carry out scheduled procedures. This also potentially diminishes the emotional stress

45 This comes from a seminar my wife attended. A community nurse (not my sister) told me, similarly, about cases of improvement of diabetes patients who have regular interviews with specialized nurses, who coach them in changing their lifestyle: while this requires more time than doing a few tests and prescribing pills, the reduction in medicine use is often spectacular.

46 Personal communication, Saskia van Lente, 29 Aug 2021. She brought to my attention the work of the Dutch pulmonologist Sander de Hosson, who is trying to get doctors to pay more attention to palliative care: Interview, *Trouw*, 20 Feb 2021.

that comes with being in more continuous contact with particular patients. Patients may miss more personal treatment, but often prefer such procedures as well, as it gives them the feeling that they are getting professional help.[47]

These preferences are likely to be culturally specific, however. Health is a culturally variable concept: it involves notions of the self and its place in the cosmos, and expectations of life. That is why people around the world deal with suffering and loss in many ways, while the cybernetic model presumes uniformity and hence global applicability. True, human bodies are basically similar around the world, but dealing with life and death is a very different matter.

Let me close this discussion of the cybernetic view of healthcare with an observation by historian of science Peter Galison. In a penetrating analysis of Norbert Wiener's pioneering work on cybernetics, he emphasizes how it arose from a need for control. Wiener's original project was to design a machine that could predict the trajectory of an enemy bomber airplane under artillery attack, in order to aim anti-aircraft fire more precisely. Wiener and his colleagues found that movements of the plane could be predicted based on its first evading manoeuvres. The more general theory derived from this was that, although human beings are not machines, much of their behaviour is mechanical, repetitive, and hence predictable. This predictability is the basis of control and order, needed to oppose the forces of chaos and destruction in this world – the experience of the Second War was an important influence on cybernetics. Galison ends with this reflection: "Cybernetics, that science-as-steersman, made an angel of control and a devil of disorder. But perhaps disorganization, noise, and uncontrollability are not the greatest disasters to befall us. Perhaps our calamities are built largely from our efforts at super-organization, silence, and control."[48] Applying Wiener's concept to healthcare, modern medicine might be seen as the angel that fights the devils— physical and emotional—of chaos created by illness and death. Abandoning the cybernetic approach or supplementing it with approaches more accepting of the world's impermanence therefore involves other ways of dealing with suffering and death; and perhaps also more faith in the intuitive and practice-based insights of healthcare workers instead of protocolizing their work from the top down, based on a necessarily limited model.

The Appeal of Cybernetic Models

The extraordinary power of the cybernetic view of human health and society can partly be explained by the deep roots of this view in western societies. That

47 I owe these insights to my sister.

48 Galison, "Ontology of the Enemy," 26.

technology is the obvious response to obstacles humans encounter is suggested by two ancient texts which have shaped much of western thought: the biblical creation story and the Greek myth of Prometheus. Both speak about using human ingenuity to assert mastery over nature.[49]

The emergence of the mechanical picture of the world and of living beings in the sixteenth century greatly enhanced this notion of the capability of humans to dominate nature. Comparing human organs with machines (the lungs as bellows, for example) goes back to ancient times, but understanding all of nature as a mechanism, comparable to the way a clockmaker understands clocks, goes back, essentially, to René Descartes (1596–1650).[50] Descartes argued that alone in the universe, humans possessed a rational soul, which gave them a god-like power over the material world (even exempting them from being God's subjects, as he wrote to Queen Christina of Sweden).[51] Ever since, scientists and philosophers have been engaged in a debate, unresolved unto the present day, about how the soul, or consciousness, is related to the body. While some argued that immaterial, spiritual powers must be part of the material world, the dominant view became that humans, like the rest of nature, are inanimate body-machines, whose movements, thoughts and feelings are caused by external stimuli.[52]

Some Renaissance philosophers were very explicit about the practical goals of what was soon called science. In his utopian story *New Atlantis* (1627) Francis Bacon described the research institute on this island as "the very eye (or: "the lanthorn") of this kingdom."[53] Its goal was the attainment of "the Knowledge of Causes, and Secret Motions of Things; and the Enlarging of the bounds of Human Empire, to the Effecting of all Things possible."[54] Several artificial materials, as well as baths, invented there, were used to cure diseases.

Descartes is more explicit still, in the sixth part of his *Discours de la Méthode* (1637).[55] If we learn to look at nature the way a craftsman looks at his craft, he says, there is no end to the improvements we can make. He mentions health specifically, because being healthy is a prerequisite to thinking clearly, and hence to developing

49 Noble, *Religion of Technology* summarizes much of the literature on this topic. His overall narrative has been strongly criticized. See for example Keith Thomas' review in *The New York Review of Books*, 45, no. 20, 17 Dec 1998.

50 This account of the debate about humans as machines draws heavily on Riskin, *Restless Clock*.

51 Riskin, *Restless Clock*, 64.

52 Riskin, *Restless Clock*, 76, 272, 278. A current popular expression of this view: Harari, *21 Lessons*, 62–70.

53 Bacon, *New Atlantis*, 7, 11.

54 Bacon, *New Atlantis*, 17–18.

55 René Descartes, *Discours de la Méthode*.

wisdom. In his closing remarks he repeats that he wants to devote what remains of his life to developing knowledge which may support the health of his fellow human beings.

The mechanical view of the world and of human beings that developed after Descartes received a new impulse in the twentieth century from electronics and cybernetics.[56] Purposeful action in animals could now be explained by feedback mechanisms. Similar mechanisms could be built into machines (the governor in steam engines and the thermostat were common examples of such mechanisms that already existed), which made them seem alive, actively able to react to their environment. The process of learning could be understood as resulting from a continuous flow of measurements, in a machine or an organism, in different situations. Intelligence was conceived as an emerging process, which required no internal cause, and which could occur in machines as much as in organisms.

The Technological Fix

Cybernetics was a powerful tool for thinking about how to engineer social improvement. But it was part of a larger, less articulated set of ideas, which has been dubbed the "technological fix."[57]

The term was coined in 1966 by the physicist Alvin Weinberg, director of the Oak Ridge National Laboratory for nuclear research, who used it in a series of lectures and articles. Soon it became widely used in controversies about technology, usually with a negative connotation: a technological fix was a simplistic solution to a complicated problem, that bypassed deeper causes and tended to make the problem worse. Weinberg's original proposals were more subtle, however. He argued that many complicated social problems could be "fixed" by rather simple technological means, at least temporarily, buying time for developing more structural solutions. The Watts race riots in Los Angeles during the hot August days of 1965 had inspired this idea. Weinberg suggested that distributing television sets and air conditioning in the city's slums would prevent further rioting, as they would alleviate personal discomfort. He added that of course the big problems of poverty and racial conflict needed to be addressed as well, but while working on those difficult issues, this quick technological fix would prevent further violence. Developing this idea, Weinberg increasingly advocated technological solutions to *bypass* approaches such as education and legislation, which attempt to change the choices people make. One

56 Riskin, *Restless Clock*, chapter 9; Galison, "Ontology of the Enemy," 228–66; Kline, *The Cybernetic Moment*.

57 The most thorough treatments are Johnston, "Alvin Weinberg" and Johnston, "Technological parables." Also Scott, *Food, Genetic Engineering*, and Rosner, *The Technological Fix*.

example was distributing Intra Uterine Devices (IUDs) as a contraceptive, which obviated the much more difficult task of making individuals change their behaviour.[58]

Sean Johnston has documented the use of the latter approach by the leader of the American Technocracy movement in the 1930s, Howard Scott. Scott's favourite example was the problem of accidents with streetcars with open platforms and steps, from which passengers regularly fell. Signs prohibiting this practice did not help, and neither did ordinances and police control. Finally, an engineer solved the problem by designing a streetcar with an enclosed platform and without external handholds. Scott believed that this example proved the general maxim that social problems can best be solved by engineers.[59]

The idea of a "technological fix" to social problems was a culmination of a long trail of western thought. But the discussion about it also provides some further clues as to why this way of thinking attracted so many people, and of its pitfalls. Technological fixes were presented as shortcuts by Weinberg and Scott to bypass complicated issues of human behaviour and social norms, or, as in Weinberg's first proposals, to buy time for developing more complicated social mechanisms. Technical solutions seemed straightforward and objective. Manufacturers presented them as smart and modern: much of the technological fix rhetoric is corporate PR.[60] A recent example, outside the field of medical technology, illustrates the point. During the recent floods in Belgium, Germany and the Netherlands, an engineer presented a device to quickly heighten dikes: a synthetic tube, placed on top of a dyke, would fill up with the rising water from the river, creating a wall which stopped the river from overflowing. Obviously, such a device will not eliminate structural causes of floods, but it is a whole lot easier as well as attractively smart.[61] Similarly, one could argue that the recent global vaccination campaign to stem the COVID crisis is a technological fix, which bypasses contributory causes of illness and death, which require a very different approach: obesity and diabetes in western countries, poverty in poorer nations, air pollution, and travelling habits—any institutions and patterns of behaviour which undermine resistance to infectious diseases.

Healthcare itself offers a clear, though painful, example of how technological fixes can create further problems, which trigger more fixes. In recent decades, medical technology has tended to extend the lives of older people who need long-term care. Medicines and devices to extend their lives are often exceedingly

58 Johnston, "Alvin Weinberg," 630–31.

59 Johnston, "Technological Parables," 199.

60 Thus Morozow, *To Save Everything,* 215, 220: technological inevitability as a marketing slogan of Silicon Valley.

61 *NRC-Handelsblad*, 24 July 2021.

expensive, and the number of people who need them increases. E-health is to a large extent a response to this problem: a clear case of a set of technologies to solve problems created by earlier technologies.[62]

In view of these limitations, it seems to make sense to consider options in addition to technological ones. The shortage of nurses could be addressed by improving their conditions of employment: pay, working hours, refresher courses, day childcare facilities, etc. And why not consider recruiting and training refugees who now languish in camps at the borders of Europe? Instead of giving elderly people robot pets, why not introduce real animals in old people's homes—something that has been shown to work wonders for the mood of depressed patients? None of this means that technological solutions should be ruled out. No, they are among a range of possible responses.

What is striking in most discussions is that options other than technology are not even considered: technology is regarded the obvious answer. And the reason for this short-sightedness, this essay suggests, is that solving social problems requires a wider and more long-term assessment of issues of health (and enrolment of the public). Social change means confronting contentious issues: admitting refugees, taking on the immense power of tech companies that profit from technological fixes, and discussing existential questions of health, life, and death.

The impulse to rely on technological solutions and disregard more difficult questions is deeply engrained in our culture. It has been enhanced by the neoliberalist wave since the 1980s. As the Dutch economist Sweder van Wijnbergen explains: Dutch neoliberal governments during the last three decades have cut budgets for all kinds of public service, loosely claiming that "digitizing" these services would make them more efficient and therefore cheaper. They had no idea of the problems involved in automating complex operations, with the result that several IT projects in government agencies ended in expensive failures, with IT companies the only winners. Neoliberalism shies away from addressing complex social problems and falls back on a well-entrenched faith in technology.[63]

Conclusion

In view of aging populations, increasing demands for care, increasing costs of new medicines and medical devices, and a number of care workers that at best does not decline, it is obvious that a crisis in public healthcare is in the making. It is also clear

62 Wetenschappeljjke Raad voor het Regeringsbeleid, *Kiezen*, 64; Ezekiel Emanuel, "Why I Hope to Die at 75," *The Atlantic Monthly*, October 2014. https://www.theatlantic.com/magazine/archive/2014/10/why-i-hope-to-die-at-75/379329/.

63 Sweder van Wijnbergen in *NRC-Handelsblad*, 16–17 Oct 2021. On failed IT projects in Dutch government services: *NRC-Handelsblad*, 29 Nov 2007, 16 April 2019, and 20–21 April 2019.

that new technologies, including robotics and AI, can help alleviate the problem. Several devices have been welcomed by healthcare workers and patients: machines that prepare warm drinks, or dispense medicines, devices for self-monitoring, and robots that can lift patients. Algorithms and databases that give doctors access to the latest medical insights have the potential to improve their diagnostic capabilities. But some new technologies promoted by healthcare managers and the industry do not work very well. So far, the overall impact of new technologies on the quality and efficiency of healthcare have been disappointing.

This essay has attempted to explain the origins of the tendency to over-estimate the potential of technological solutions and the reluctance to address the deeper and more complicated dimensions of health. The critical situation we are facing requires a more open-minded approach, which must start with understanding the power of the deeply entrenched frames of thinking that dominate current debates about healthcare.

Biography

Dick van Lente is a cultural historian, who retired in 2018 from the history department of Erasmus University Rotterdam. He serves the journal *Technology and Culture* as review editor.

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Bibliography

Abnet, Dustin. "Americanizing the Robot: Popular Culture, Race, and the Rise of a Global Consumer Icon, 1920–60." *ICON* 27, no. 1 (2022): 15–35.

Bacon, Francis, *New Atlantis*. 1627. Project Gutenberg.

Berg, Maxine. *The Machinery Question and the Making of Political Economy 1815–1848*. Cambridge: Cambridge University Press, 1980.

Brynjolfsson, Erik and Andrew McAfee. *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*. New York: Norton, 2014.

Carlyle, Thomas. "Signs of the Times." (1829) In *Thomas Carlyle. Selected Writings*, edited by Alan Shelston, 61–85. Harmondsworth: Penguin, 1980.

Cohen, John. *Human Robots in Myth and Science.* London: Allen & Unwin, 1966.

Corn, Joseph J. *The Winged Gospel: America's Romance with Aviation, 1900-1950*. New York: Oxford University Press, 1983.

Czitrom, Daniel J. *Media and the American Mind: From Morse to McLuhan*. Chapel Hill: University of North Carolina Press, 1982.

De Vries, Tity. *Complexe Consensus. Amerikaanse en Nederlandse Intellectuelen in Debat over Politiek en Cultuur 1945-1960*. Hilversum: Verloren, 1996.

Dennett, Daniel. *From Bacteria to Bach and Back: The Evolution of Minds*. Harmondsworth: Penguin, 2017.

Descartes, René. *Discours de la Méthode.* 1637. Project Gutenberg.

Dittmann, Frank. "Golem, Homunculus und Robot – zum Diskurs um künstliche Wesen vor 100 Jahren." In *Informatik und Gesellschaft. Festschrift zum 80. Geburtstag von Klaus Fuch-Kittowski,* edited by F. Fuchs-Kittowski and Werner Kriesel, 123–36. Frankfurt a.M.: Peter Lang, 2016.

Edgerton, David. *The Shock of the Old. Technology and Global History Since 1900*. London: Profile books, 2008.

Franchi, Stefano, and Güven Güzeldere, eds. *Mechanical Bodies, Computational Minds. Artificial Intelligence from Automata to Cyborgs*. Cambridge, MA: The MIT Press 2005.

Galison, Peter. "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision," *Critical Inquiry* 21 (1994): 228–266.

Gugerli, David. *Wie die Welt in den Computer Kam. Zur Entstehung Digitaler Wirklichkeit*. Frankfurt am Main: Fischer, 2018.

Harari, Yuval Noah. *Sapiens. A Brief History of Humankind.* London: Harville Secker, 2014.

Harari, Yuval Noah. *Homo Deus: A Brief History of Tomorrow*. London: Vintage, 2015.

Harari, Yuval Noah. *21 Lessons for the 21st Century*. London: Penguin, 2019.

Johnston, Sean F. "Alvin Weinberg and the Promotion of the Technological Fix." *Technology and Culture* 59, no. 3 (2018): 620–51.

Johnston, Sean F. "Technological Parables and Iconic Illustrations: American Technocracy and the Rhetoric of the Technological Fix." *History and Technology* 33, no. 2 (2017): 196–219.

Jordan, John. *Robots*. Cambridge, MA: The MIT Press, 2016.

Jungk, Robert. *Die Zukunft hat Schon Begonnen. Amerikas Allmacht und Ohnmacht*. Stuttgart, Hamburg: Scherz & Goverts Verlag, 1952.

Judt, Tony. *Postwar. A History of Europe Since 1945*. New York: Penguin, 2005.

Kline, Ronald R. *The Cybernetics Moment. Or Why We Call Our Age the Information Age*. Baltimore: Johns Hopkins University Press, 2015.

Lange, Nicholas and Frank Dittmann. "Toys, Drones and Humanoids: The New Robotics Exhibition at the Deutsches Museum, Munich." *ICON* 27, no. 1 (2022): 81–96.

Morozov, Evgeny. *To Save Everything, Click Here: Technology, Solutionism and the Urge to Fix Problems that Don't Exist*. London: Penguin, 2013.

Noble, David F. *Forces of Production. A Social History of Industrial Automation*. New York: Oxford University Press, 1984.

Noble, David F. *The Religion of Technology: The Divinity of Man and the Spirit of Invention*. New York: Knopf, 1997.

Nye, David E. "Harari's World History: Evolution toward Intelligence without Consciousness?" *Technology and Culture* 62, no. 4 (2021): 1219–28.

Polak, F.L. *De wentelgang der Wetenschap en de Maatschappij van Morgen* [The revolution of tomorrow's science and society]. Inaugurele oratie bij de aanvaarding van het ambt van buitengewoon hoogleraar aan de Nederlandse Economische Hogeschool, Rotterdam, 27 Oct 1949, Second Expanded Edition. Leiden: Stenfert Kroese [1950].

Polak, Fred. *Automatie. Industriële en culturele revolutie* [Automation: Industrial and cultural revolution]. Zeist: De Haan, 1958.

Polak, Fred. *De Nieuwe Wereld der Automatie. Een Industriële en Sociaal-Culturele Revolutie* [The new world of automation: An industrial and socio-cultural revolution]. Hilversum: De Haan, 1966.

Polak, Fred L. and H.F. van Loon, ed. *Gesprek met Morgen* [Discussion with tomorrow]. Bussum: Teleboek, 1968.

Radkau, Joachim. *Geschichte der Zukunft. Prognosen, Visionen, Irrungen in Deutschland von 1945 bis Heute*. München: Carl Hanser Verlag, 2017.

Ramunni, Girolamo, ed. *Et l'Homme Créa le Robot*. Paris: Musée des Arts et Métiers, 2012.

Riskin, Jessica. *The Restless Clock: A History of the Centuries-long Argument over What Makes Living Things Tick*. Chicago: University of Chicago Press, 2016.

Robertson, Jennifer. *Robo Sapiens Japanicus: Robots, Gender, Family, and the Japanese Nation*. Oakland, CA: University of California Press, 2018.

Rosner, Lisa, ed. *The Technological Fix: How People Use Technology to Create and Solve Problems*. New York: Routledge, 2004.

Royakkers, Lambèr, Floortje Daemen and Rinie van Est , *Overal Robots. Automatisering van de Liefde tot de Dood* [Robots everywhere: Automation from love to death]. Den Haag: Boom Lemma, 2012.

Scott, Dane. *Food, Genetic Engineering and Philosophy of Technology*. Cham, Switzerland: Springer, 2018.

Seefried, Elke. *Zukünfte. Aufstieg und Krise der Zukunftsforschung 1945–1980*. Berlin: De Gruyter Oldenbourg, 2015.

Segal, Howard, *Utopias. A Brief History from Ancient Writings to Virtual Communities*. Chichester: Blackwell, 2012.

Supp-Montgomery, Jenna. *When the Medium was the Mission. The Atlantic Telegraph and the Religious Origins of Network Culture*. New York: New York University Press, 2021.

Van der Helm, Ruud. "The Future According to Frederik Lodewijk Polak. Finding the Roots of Contemporary Future Studies." *Futures* 37 (2005): 505–19.

Zahn, Thomas P. "Lernende Maschinen – Fluch oder Segen?" *Monitor Versorgungsforschung* 03 (2018): 6–13.