Perspectives on Artificial Intelligence in Europe

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While artificial intelligence (AI) as a technology has been gaining widespread media and popular attention, its historical analysis is still in its infancy. As Jon Agar noted, "There is a surprising absence in the secondary literature of survey histories of artificial intelligence written by professional historians of science" [4, p. 291].[1] When we began our own project on the history of AI in the Federal Republic of Germany,[2] we found that we had to agree: Each project member—there are five of us (Florian Müller, Dinah Pfau, Helen Piel, Rudolf Seising, and Jakob Tschandl)—individually investigates one subject area of AI and has often found little historical work.[3] What is more, the available histories, both monographs and articles, strongly focus on US developments (occasionally including British developments, Alan Turing, and Donald Michie) and are often written by practitioners and nonhistorians [12], [14], [16], [25], [34], [42], [63]. This prevalence of practitioner (as well as popular) accounts is being replicated outside the US too [9], [10], [11], [53]. While valuable as sources, these can only be a first step toward a thorough historical analysis of AI that extends beyond its US origins. This Special Issue therefore collects several histories of AI in Europe by historians and media theorists.

The beginnings of AI can be traced back at least over three-quarters of a century. In the early 20th century, for instance, cybernetics presumed structural equivalence between organisms and machines regarding control and communication processes.[4] But it was the digital computer, along with cybernetics and mathematical information theory that opened up possibilities of realizing "artificial intelligence." When early computers were presented to the public in the 1940s, the press quickly compared them to the human brain [32].[5] Analogies from biology also found their way into the scientific literature on computers. In 1943, Warren McCulloch and Walter Pitts published a paper, "A logical calculus of the ideas immanent in nervous activity" [35], [29]. Following cybernetic ideas, they tried to show equivalence on the level of processes: they suggested that brain activities can be seen as following logical rules, similarly to how computers are logical machines. John von Neumann read the paper and he took over some of McCulloch and Pitts' terminology in his 1945 draft report on the EDVAC. Specifically, he described parts of the computer as "organs" or "neurons" and called its storage "memory" [58]. (Both von Neumann and McCulloch were aware, however, that their analogies were simplifications and idealizations [29], [60].) Over time, the analogy was reversed [49], [62]. By 1961, for instance, British psychologist and cyberneticist Frank H. George felt justified "to regard the brain itself *as if* it were a computer-type control

[1]Of course, this does not mean that no secondary literature exists at all; including Agar's article a few specific case studies have been published: Babintseva, Mind; Edwards, *World*; Ensmenger, Chess; Dick, AfterMath; Kline, Cybernetics; Penn, Intelligence. Two mentionable sociological works are Fleck, Development (for the Anglo-American context), and Ahrweiler, *Intelligenz-Forschung* (for the German context).

[2]"IGGI: Ingenieur-Geist und Geistes-Ingenieure. Eine Geschichte der Künstlichen Intelligenz in der Bundesrepublik Deutschland", funded by the Federal Ministry of Education and Research (BMBF, grant number 01IS19029).

[3]The individual projects focus on natural language processing, image processing, cognitive science, automated theorem proving, and expert systems. More information at [Online]. Available: https://www.deutsches-museum.de/en/forschung/forschungsinstitut/projekte-und-forschungsbereiche/projects/detail-page/iggi-ingenieur-geist-und-geistes-ingenieure [20.7.2023].

[4]The classic work setting up cybernetics as a research program is Wiener, Cybernetics. For a historical overview see Heims, *Cybernetics*; Umpleby, History; Pias, *Cybernetics* collects all transcriptions and protocols, with additional historical contextualization. For a non-US context, see Gerovitch, *Newspeak*; Medina, *Revolutionaries*.

[5]The following two works have traced the history of ideas about the brain over a longer period of time, including chapters on the computer metaphor: Cobb, *Idea*, and Draaisma, *Metaphors*.

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system, in the belief that by doing so we are making *explicit* what for some time has been *implicit* in the biological sciences" [23, p. 1]. Several scientists began understanding thought as information processing and finally suggested using computers to study human intelligence on the one hand, and on the other to attempt to create "artificial intelligence."

The term "artificial intelligence" is usually attributed to John McCarthy. In a 1955 funding application for a research project, co-written with Claude Shannon, Marvin Minsky, and Nathaniel Rochester, McCarthy defined AI as based on the premise that "every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it" [33]. This research project, or rather, a several weeks-long scientific meeting, took place over the summer of 1956 at Dartmouth College, New Hampshire. It had partly grown out of McCarthy's dissatisfaction with a collection he and Shannon were editing in the early 1950s, called *Automata Studies* [54]. While the majority of contributions focused on mathematical–logical automata and a third of the book was dedicated to the so-called Turing machine, McCarthy had originally planned for this volume to be on "intelligent machines" [30], [43, chapter 4]. The Dartmouth proposal was an attempt to bring together researchers interested in such "intelligent machines."

Yet since its beginning, the research program AI has no well-defined boundaries and has been hard to characterize satisfactorily because it draws on a number of disciplines, concepts, and methods. Terminological difficulties renewed the discourse on the nature of intelligence, touching upon psychology. This combination resulted in cognitive science, which established itself as a separate field while maintaining close links to AI.[6] In 1961, Marvin Minsky surveyed the emerging field, laying out a research agenda for AI that included five main research areas: search, pattern recognition, learning, planning, and induction [38], [43, chapter 5]. By the mid-1970s, these had stabilized and further diversified into subject or application areas and methods, described and visualized by Nils Nilsson in another survey of AI [41]. In applications, AI research was finding its way into robotics, machine vision, game playing, and more.

In Europe, meanwhile, similar topics were also on the agenda, and international conferences, scientific (correspondence) networks, and travels for research trips or international study facilitated knowledge exchange across the Atlantic. In fact, both Minsky and Nilsson had been at European conferences around the time they published their AI surveys: Minsky organized a symposium on AI at the 1962 IFIP Congress in Munich [39], and Nilsson's survey was presented as an invited talk at the 1974 IFIP Congress in Stockholm [41]. Our own research found that both were commented on by the West German AI community [40], [56], [31], [55] and presumably researchers from other European countries did so as well. There is an even earlier conference that enabled US and European researchers interested in cybernetics- and AI-related topics to meet and discuss: In 1958, the National Physics Laboratory near London organized and hosted the meeting "The Mechanisation of Thought Processes." The title highlights the equating of technological and biological processes typical of cybernetics and at the root of AI's idea that machines could be made to "think." Matthew Cobb takes an in-depth look at this meeting, made possible by the very detailed proceedings which include the discussions that took place after the talks. He draws out key commonalities and problems as well as critiques; the Israeli linguist and philosopher Yehoshua Bar-Hillel was especially vocal.

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The rate of development of AI varied from country to country, however, though it too can be traced back to the middle of the last century. Looking at Germany (both East and West) and Britain, the countries on which the contributions to this Special Issue focus, research areas important for the emergence of AI were part of the scientific landscape: Cybernetics [7], [46], [47], [48] research was done since the 1950s, and computer science [3], [6, chapters 3 and 6], and informatics (*Informatik* in German) [50] emerged in the 1960s. Hans-Christian von Herrmann shows how early cyberneticists and computer scientists as well as poets, novelists, and artists discussed the possibilities of machine creativity. For many there was an appeal in

[6]There are book-length histories of cognitive science, though only by non-historians: the first was Gardner, *Science;* Boden, *Mind* is more recent.

machines that (appeared to) cross into the realm of aesthetics by creating indeterminate outputs.

Other cybernetic discussions took place in the Ratio Club, an informal dining club where British cyberneticists met during the 1950s [21], [28], [47]. One member was Alan Turing [28], whose 1950 paper "Computing intelligence and machinery" had a lasting influence on AI. Jack Copeland offers a survey of Turing's early contributions to machine intelligence and topics that later became known as (part of) AI. He also highlights how Turing and his work inspired early computer scientists who began moving into machine intelligence research.

Early British AI began to establish itself in Edinburgh, when geneticist-turned-AI-researcher Donald Michie, who had previously worked with Turing at Bletchley Park, setup an "Experimental Programming Unit" in 1963, out of which quickly grew the Department of Machine Intelligence and Perception [21]. Two years later, Michie began organizing the machine intelligence workshops and became editor-in-chief to the associated book series *Machine Intelligence* [21]. In 1964, partly with Michie's encouragement, what is likely to be the world's first society concerned with AI was founded: the Society for the Study of Artificial Intelligence and Simulation of Behaviour.[7] A West German equivalent followed in 1975 as part of the German Informatics Society [44], an East German one in 1985/1986 (in the Informatics Society of the GDR) [37]. In West Germany, the narrative of a "technological gap" with the US and of running behind its AI developments emerged, though it was also contested by contemporaries [51], [44]. These and other discussions took place during conferences and beyond; they were reported on in the newsletters of the West German AI society. These "KI-Rundbriefe," considered a cornerstone of the emerging AI community, are analyzed by Dinah Pfau, Helen Piel, Florian Müller, Jakob Tschandl, and Rudolf Seising. Looking at research reports in particular, they trace the involvement of editors and show that the newsletters only partially represent the West German AI research landscape. This landscape—similar to what Nilsson had described for the US in 1974—can be divided into different subject areas and methods. Especially during early years of artificial intelligence, (board) games were a popular topic on both sides of the Atlantic and behind the Iron Curtain [20], [27], [52], [58]. Using the computer game chess-master as a lens, Martin Schmitt sheds some much needed light on AI in the GDR. With a focus on application in the phase of late socialism, AI in East Germany refers to similar subject areas and used similar methods to those of the West.

This Special Issue can only offer a selection of possible histories of AI in Europe. We are sure that many more histories can be told about other countries and contexts and are looking forward to learning about them in the future.

[7]Fleck, Development; [Online]. Available: https://aisb.org.uk/ [14.7.2023]. The ACM's Special Interest Group on Artificial Intelligence SIGART, today SIGAI, was founded in 1966. [Online]. Available: https://sigai.acm.org/main/ [14.7.2023].

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