HISTORY AND HISTORIOGRAPHY OF COMPUTING AND TELECOMMUNICATIONS IN GREECE: FROM HUMAN COMPUTERS TO ELECTRONIC MAINFRAME AND HOME/PERSONAL COMPUTERS

ARISTOTLE (ARISTOTELIS) TYMPAS
Professor of the History of Technology in Modernity
Department of History and Philosophy of Science
School of Science, National and Kapodistrian University of Athens

I. Introduction: Historical Periods, Historiographical Issues

The present chapter aims at a synthetic reading of contributions to the history of computing in Greece.[1] Given the historical convergence (if not the

[1] Authored, mostly, by members of the Department of History and Philosophy of Science and its graduate programs, these contributions would have been impossible without the multidimensional support by dear colleagues from the Department of Informatics and Telecommunications, including Emeritus Professor Thomas Sfikopoulos, former university Vice-Rector, who has served as Chair of this Department between 2000-2003 and 2006-2010. Over the course of the last 15 years, I had the opportunity to benefit greatly from the feedback of colleagues and students of this department, especially in the context of teaching the undergraduate course 'History of Computing and Telecommunications' and co-teaching the graduate course 'Science, Technology, Society: Computing and Telecommunications'.

The review of the state-of-the-art literature on the international history of computing of this section relies on a presentation prepared in the context of the research project 'The Perils of Prediction in the Physical Sciences: Historical and Epistemological Perspectives (PYTHIA)', which is funded by the H.F.R.I. I want to thank Professor Theodore Arabatzis, a department colleague and Principal Investigator of the project, for his valuable feedback on this review. For gathering and annotating the contributions that I review in the rest of the sections of this chapter, I could count on expert assistance by Antonis Kechrimparis, author of an insightful graduate thesis on aspects of the labor history of computing in Greece. Finally, while working on this chapter I benefited by extremely helpful comments by Dr. Manolis Simos, an expert in the philosophy and intellectual history of artificial intelligence.

The historiographical synthesis of this chapter, which focuses mostly on research undertaken at the National and Kapodistrian University of Athens, may be read together with an overview

inseparability) of computing and telecommunications, it also includes references to available contributions on the history of the integration of computing into telecommunications.[2] The chapter starts with an introduction to a scheme of historical periodization (and the research priorities it both assumes and advances), informed by recent contributions to the international historiography of computing. The rest of the sections introduce contributions to the history of computing in Greece by taking into account (and seeking to enrich) this introductory periodization scheme.

In the postwar period electronic computing came to overwhelm just about everything, including scientific computing.[3] As a result, hundreds of historians worldwide are by now specializing in this subfield of the history of science and technology. However, with many of them being amateurs, the subfield as a whole has been struggling to move beyond a spontaneous internalism (evolutionism, progressivism), which tend to detach the computer from the computer-society co-shaping.[4] In recent years, though, parallel to the maturing of a generation of professional historians of computing, critical

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of the history of computing in Greece by a team of colleagues from the Athens University of Economic and Business, led by Professor Diomidis Spinellis. See Dritsa, Konstantina, Mitropoulos, Dimitris and Spinellis, Diomidis (2018) "Aspects of the History of Computing in Modern Greece", *IEEE Annals of the History of Computing,* 40:47-60.

[2] "In a historical sense", writes Carolyn Marvin, a distinguished contributor to the cultural history of technology, "the computer is no more than an instantaneous telegraph with a prodigious memory, and all the communications inventions in between have simply been elaborations on the telegraph's original work". Marvin, Carolyn (1990) *When Old Technologies Were New: Thinking About Electric Communication in the Late Nineteenth Century*, Oxford, UK: Oxford University Press, p. 3. For an updated edition of a standard introduction to the history of computing, see Haigh, Thomas and Ceruzzi, Paul (2021) *A New History of Modern Computing*, Cambridge, Massachusetts: The MIT Press. I had the opportunity to recommend the translation of an earlier edition into the Greek language. See Ceruzzi, Paul (2006) *Ιστορία της Υπολογιστικής Τεχνολογίας: Από τον Eniac έως το Διαδίκτυο*, Επιμέλεια: Αλέξανδρος Χάλαρης, Μετάφραση: Ιωάννης Οικονόμου, Αθήνα: Κάτοπτρο. For a Greek translation of an introduction to the history of telecommunications, see Flichy, Patrice (2004) *Η ιστορία της Σύγχρονης Επικοινωνίας: Δημόσια Σφαίρα και Ιδιωτικός Βίος,* Επιμέλεια: Αλέξανδρος Χάλαρης, Μετάφραση: Νανά Μυριαγκού, Αθήνα: Κάτοπτρο.

[3] Misa, Thomas (2007) "Understanding 'How computing has changed the world", IEEE Annals of the History of Computing, 29(4): 52-63.

[4] Gugerli, David and Zetti, Daniela (2019) 'Computer history: The pitfalls of past futures', *PREPRINTS ZUR KULTURGESCHICHTE DER TECHNIK*, 33.

additions to the literature on the history of computing came to sensitize us to a set of key changes.

The first change concerns the use of the concept 'computer'. Namely, it is the change from the pre-World War II (and early postwar) use of the concept to signify a human worker, usually a woman, to its use to refer to a machine.[5] The change of reference from a human computer to a computer machine was inseparable from another change, that of the 1940s emergence of the analog-digital demarcation.[6] This demarcation was followed, in the 1950s, by the software-hardware one and, later, by a demarcation between 'customized' software and standardized software – the latter subsumed under an 'operating system'.[7] The second key change is the one from the large computer 'mainframes' of the 1940s to the 'microcomputers' of the post-1970s ('home' and 'personal' ones) and, more recently, in post-1990s, the massive network of computers that gave rise to the 'internet', the 'web', and a range of 'social media'.[8] The third change emerged from an expansive datafication that resulted from the accumulation of 'big data', combined with a change in algorithms; namely, from mostly mathematical-logical-programming ones to algorithms defined by their feeding on big data of all kinds.[9] These algorithms and their big data define the ongoing version of the so called 'artificial intelligence'. The fourth key change is, actually, about, continuities and changes in the interrelations among work, computing technology and the ideology that attributes artificial

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[5] Grier, David Alan (2005) *When Computers Were Human*, Princeton, New Jersey: Princeton University Press. For a Greek translation of the history of the human computers who run the ENIAC, the so called 'first' electronic computer, see Light, Jennifer (2015) «Όταν οι υπολογιστές ήταν γυναίκες», στο Τέλης Τύμπας και Ειρήνη Μεργούπη-Σαβαΐδου (επιμέλεια), *Ιστορίες της Τεχνολογίας του Εικοστού Αιώνα*, Μετάφραση: Σάντυ Σακορράφου, Ηράκλειο: Πανεπιστημιακές Εκδόσεις Κρήτης, 217-270.

[6] Tympas, Aristotle (2020) "From the display of a digital-masculine machine to the concealed analog-feminine labour: The passage from the history of technology to labour and gender history", *Historein*, 19(1) (https://ejournals.epublishing.ekt.gr/pfiles/journals/14/editor-uploads/issues/1165/main1165.html?1=1165&2=19134).

[7] Ensmenger, Nathan (2012) *The Computer Boys Take Over: Computers, Programmers, and the Politics of Technical Expertise*, Cambridge, Massachusetts: The MIT Press, Campbell-Kelly, Martin (2003) *From Airline Reservations to Sonic the Hedgehog: A history of the Software Industry*, Cambridge, Massachusetts: The MIT Press.

[8] Haigh and Ceruzzi *A New History of Modern Computing.*

[9] Strasser, Bruno J. and Edwards, Paul N. (2017) "Big data is the answer but what is the question?", *Osiris*, 32: 328-345.

intelligence to machines, from the rhetoric about the coming of a 'postindustrial society' of the 1970s to the '4th industrial revolution' of the 2010s.[10]

Amateur historians tend to neglect everything that has been closer to humble pocket electronic calculators (extensively used for everything, including state-of-the-art scientific computations), over-emphasizing everything that is closer to electronic supercomputers. Similarly, they assume a linear transition from electronic mainframes (post 1940s), minicomputers, that is home and personal computers (post 1970s), and the networked computer (most recent decades). This transition was not the outcome of a linear development, but, of a contingent and open-ended history. For example, the course of computing history was affected by the crucial 1960s-1970s contrast between the IBM-type of mainframe computing and the drive for 'time-sharing' to support computer 'utilities', similar to energy, water and telecommunication utilities.[11] The concept of a computer utility was based on the linking of a mainframe computer to many distant users through an appropriate configuration of the telecommunications network. The transition from mainframes to minicomputers and, by now, the networked computer is actually present in every dimension of the history of computing. Notably, it interacted with the co-extensive transition from artificial intelligence referring to 'electronic brains' that imitate the human brain (mainframe era) to 'artificial agents' seeking to replace experts (late mainframe era to minicomputer era) and, more recently, to artificial intelligence that appears to be ubiquitous, based on the mass availability and interconnection of minicomputers.[12]

The historiographical picture from the maturing of a generation of professional historians of computing points to an urgent need to integrate into the history of computing a critical periodization scheme, based on a series of important demarcations and concepts. To recapitulate, this scheme may start by dividing the history of electronic computing into three periods: one marked by the availability of electronic computer mainframes, one shaped by the

[10] Aristotle Tympas, Giorgos Zoukas and Kostas Sakalis (2020/2021), 'Shifting public discourses on artificial intelligence and robotics amidst crisis: From the 'postindustrial society' (1970s) to the 4th Industrial Revolution (2010s)', Virtual ICHOTEC Conference.

[11] Campbell-Kelly *From Airline Reservations to Sonic the Hedgehog.*

[12] For an historiographical introduction to the history of artificial intelligence, see Garvey, Colin (2018) "Broken promises & empty threats: The evolution of AI in the USA, 1956-1996", *Technology's Stories* 6(1) (https://www.technologystories.org/ai-evolution/).

configuration of personal and home microcomputers, and, more recently, one defined by the networking of these computers. Eventually, the periodization of the history of electronic computing must find a way to rely more directly on the series of the demarcations mentioned above: computer machines (postwar) vs human computers (prewar); digital vs analog side (introduced in the 1940s); hardware vs software (introduced in the 1950s/1960s, replaced the digital vs analog one); software operating system vs applications/customized software (introduced in the 1970s/1980s). All of the above actually run parallel to an additional series of demarcations: computation vs analysis, computation vs calculation, computation vs simulation, and computation vs modeling.

Last but not least, the history of electronic computing as a whole (and, therefore, its three sub-periods) may not be treated in isolation from a broader periodization scheme, which would have to acknowledge the centrality of computing science and technology throughout the centuries of capitalist modernity, merchant and industrial. Computing science and technology did not become of constitutive importance to modern societies during the electronic era. They were equally indispensable during the mechanical (first industrial revolution: steam engine) and electrical era (second industrial revolution: dynamo, motor and the lines linking the two). The sixteenth century ships and the nineteenth century trains that were used to travel humans around the earth—just like the mid-twentieth century spacecrafts that took them to the moon—would have been impossible without a myriad of computing artifacts: nomographs/nomograms and many other graphs, general and special purpose slide rules (logarithmic and other), mechanical/desktop calculators (calculating machines), punched-card machines, analyzers (tide predictor, differential and network analyzer), tables (mathematical and other, general and special purpose), to name a few.[13] And from this only indicative list we should not omit extremely significant computing artifacts that also emerged early in capitalist modernity (a modernity made possible by their use), like the differential and

[13] Tympas, Aristotle (2017) *Calculation and Computation in the Pre-electronic Era: The Mechanical and Electrical Ages*, London, UK: Springer. For a first-class study of how these computing artifacts were used in critical contexts, which makes references to the Greek case, see Καραμπάτσος, Χρήστος (2021) «'Μαγικό εργαλείο αυτός ο υπολογιστικός κανόνας!': Η τεχνοπολιτική διάσταση και η ιστοριογραφική σημασία της κατά Φρέντρικ Τέιλορ 'Επιστημονικής Οργάνωσης της Εργασίας'», *Νεύσις,* 27/28: 255-282.

integral calculus and the many versions of scientific and engineering calculus that followed, logarithms, and trigonometry.

The availability of the electronic mainframe computers did not mean that this extremely rich tradition of mechanical and electrical computing artifacts disappeared overnight. On the contrary, it remains important (if not dominant) throughout (at least) the mainframe era. The electronic computer, its hardware and software, emerged by dynamically capitalizing on the myriad of computing artifacts of this tradition, and not by its static replacement.[14] Amateur historians usually miss the history of these computing artifacts, and, as a result, tend to overlook the history of the human computers who worked with them.

II. History of Computing in Greece: From Human Computers to Electronic Mainframe Computers

Pilot research on the history of computing in Greece has shown that the concept 'υπολογιστής', now referring to a computer machine, was earlier used in connection to a human worker. A human was called 'λογιστής' (or, one class below, 'υπολογιστής') when producing computations through the use of, for example, mechanical desktop calculators. Research on interwar editions of Greek newspapers retrieved references to Greek human computers all the way from banking to military institutions. Their salaries could be relatively high when the human computers were males.[15]

In her study of the pre-war use of punched-card computing machines, Polyxeni Malisova has found human computers working in the context of the 1920 census of Greece, on top of their presence in banking and other institutional environments. Despite being placed low in the hierarchy, their work was demanding and tiring. It started with the process of punching holes in a card, which required special focus and skill. In accordance with the gender stereotypes

[14] Ibid.

[15] Τύμπας, Τέλης (2011) 'Η αθέατη εργασία ως σύμπτωμα του λόγου περί έξυπνης τεχνολογίας: Για το ιστοριογραφικό πέρασμα από το ψηφιακό υλισμικό στο αναλογικό λογισμικό', Συνέδριο *ΙΣΤΟΡΕΙΝ 'Ιστορία της εργασίας: νέες προσεγγίσεις σε ένα παλιό θέμα',* Αθήνα, 20-21 Μαΐου (http://www.historein.gr/2011/05/computer.html).

of the era, which presented women as naturally disciplined and patient, the human computers working in the punching process were low-salaried females.[16]

In the international case, the change in the use of the concept 'computer' (from humans to machines) took place rather quickly in the 1940s. Interestingly, in Greece it took longer to call the machine computer 'υπολογιστής'. The evidence so far suggests that deeply into the mainframe era (which means up to the 1980s), the machine computer was usually referred to as 'διερευνητής' ('investigator') or, usually, simply as 'mechanical brain' ('μηχανικός εγκέφαλος') or 'electronic brain' ('ηλεκτρονικός εγκέφαλος').[17]

The introduction of arrays of punched card machines (most importantly 'sorters' and 'tabulators', placed in between punching and printing apparatuses), by IBM and the companies that it succeeded, goes back to the 1880s. Well before the 1940s, punched card machinery were used for computing around the world, all the way from census offices and accounting/payroll (state and business) departments to scientific laboratories, mathematical and other. This long and broad use produced the work flow protocols that made possible the architecture and the flow charts of the postwar electronic mainframe computer. In many computing environments, the continuity between the last IBM-type punched card machines and the first IBM-type mainframe electronic computers is striking.[18]

An early use of electronic mainframes is described in considerable detail in a history of the National Bank of Greece that is authored by Alexandros Kyrtsis, professor at the Political Science and Public Administration Department of the National and Kapodistrian University of Athens. Kyrtsis' history, which covers the 1950-2008 period, advances an argument about the pioneering role of banks in technological and organizational matters that rely heavily on computing and

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[16] Μαλισόβα Πολυξένη (2018) *«Αυτές οι κάρτες δεν είναι νεκρές»: Περιπτώσεις από την ιστορία της εισαγωγής μηχανών διάτρητων καρτών στην Ελλάδα*, Διπλωματική Εργασία, ΕΚΠΑ, Αθήνα.

[17] The use of the concepts 'investigator' and 'brain' through the mainframe era is confirmed by Antonis Kechrimparis' study on the labor history of computing in Greece from the 1960s to the 1980s. See Κεχριμπάρης, Αντώνης (2020) *«Πρόοδος του Πολιτισμού»: Η ρητορική της εισαγωγής υπολογιστών στον Ελληνικό Τραπεζικό τομέα, 1960-1970*, Διπλωματική Εργασία, ΕΚΠΑ, Αθήνα.

[18] Ceruzzi, Paul (1997) "Crossing the divide: Architectural issues and the emergence of the stored program computer, 1935-1955", *IEEE Annals of the History of Computing*, 19(1): 5-12.

telecommunications. Its narrative starts with the efforts to create a computing center, which lasted from the end of the war to 1954, which is when this center started to operate. The involvement of IBM was so crucial that as late as in 1965 it was called the 'IBM Computing Center' ('Λογιστικό Κέντρο IBM'). The architecture of the building that hosted the Center was more typical of a factory than of a bank. Its operation made invisible a series of computing works that were previously undertaken locally, frequently in front of the customers. While giving us details of the working conditions before and after the introduction of electronic computers, Kyrtsis confirms that the Center looked more like a noisy assembly line than a banking operation, due to the control in the pace of computing work afforded by the introduction of electronic mainframes. The salaries were generally better, in exchange of a challenging factory environment. The place was actually called a "factory of the computers" ("εργοστάσιο λογιστών»), which in this case meant, most probably, human computers (λογιστές).[19]

The relatively attractive salaries of male employees were also an antidote to the many technical challenges that had to be addressed by the bank technicians, some of whom may be best described as pioneer Greek programmers. They had to adjust creatively the electronic computing technology to the local context through the writing of programs that took into account the peculiarities of a Greek bank. Including, for example, the ones that had to do with the unique Greek island and mountain geography, which made the network of local branches relatively difficult to reach. Kyrtsis insightfully connects the workings of the computing machinery at this center to the expansion of the country's telecommunication network. Without an expanding telecommunications network, to make possible the timely sending of computing input at the Center, just like the timely return of the computing output, a computing center would have been meaningless. Kyrtsis sees here an initial phase of the history that led to the transformation of banking into an organization that is as much about available financial capital as about appropriate electronic computing and telecommunications.[20]

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[19] Κύρτσης, Αλέξανδρος Α. (2008) *Εθνική Τράπεζα της Ελλάδος: Τεχνολογική και Οργανωτική Πρωτοπορία 1950-2000,* Αθήνα: Εθνική Τράπεζα της Ελλάδος.

[20] Ibid.

Gender, Work, Technology, a book by Maria Stratigaki, a professor at the Department of Social Policy, Panteion University, nicely adds a gender focus on the history of the introduction and use of computers in the Greek banking sector. Written before the 2008 book by Kyrtsis, this 1992 Stratigaki book is focused more on the social stereotypes that came into play when mainframe electronic computers made it to the National Bank of Greece. Reading Stratigaki confirms that the introduction of mainframes did not necessarily improve the conditions of work. In this case, she argues, the electronic mainframes were used to increase the control of the employees by the management while making their work more intensive. Of particular importance is her argument regarding the differentiation between programming/analysis, which became the domain of males, and data entry, which ended up being an exclusively female computing work. With the challenging environment of a computing factory, which some employees called the "Dachau", the ideology of "dexterious [female] hands and intelligent [male] minds" made possible a further division of computing labor along gender lines.[21]

To be sure, the vast majority of Greeks had no first-hand experience of an electronic computer of the mainframe type. Mainframes were inaccessible and invisible. The ongoing dissertation work by Kostas Sakalis on the history of artificial intelligence in Greece, and a graduate thesis by Antonis Kechrimparis, came to clarify that the electronic mainframe computers of the 1960s were known mostly through their presentations in newspapers and periodicals. These presentations painted a much rosier picture than the one we find in the books by Stratigaki and Kyrtsis. Kechrimparis' research on the 1960s rhetoric of the banking journal called *Banking Economotechnical Review* (*Τραπεζική Οικονομοτεχνική Επιθεώρηση*) showed that mainframes were portrayed as symbols of modernization and exemplars of progress, due to being automatic and therefore capable of reducing substantially (if not fully eliminating) the need for (and dependence on) human work. On the grounds of their intelligence, they were supposed to be capable of freeing humans from monotonous and boring work. This discourse was in sharp contrast with the actual conditions at the National Bank Computing Center of the same period that we know from Stratigaki and Kyrtsis.[22]

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[21] Στρατηγάκη, Μαρία (1992) *Φύλο, Εργασία, Τεχνολογία*, Αθήνα: Ο Πολίτης.

[22] Konstantinos Sakalis and Aristotle Tympas (2021), 'Writing the history of Artificial Intelligence from a peripheral/southern context: The experience from a non-

III. History of Computing in Greece: Home/Personal Electronic Computers

As late as the end of the 1970s, the use of electronic computers in Greece was limited to mainframes installed at large business and state institutions. This started to change in the early 1980s, when the first home and personal computers (the two versions of minicomputers) made it to the country. According to a popular belief, the definition of the computer as a 'universal machine' (and, similarly, a 'general purpose machine') entails that it is independent of local peculiarities, a machine capable of operating automatically regardless of socio-political context. Based on this, we could be misled to assume that the history of minicomputers in Greece started by a simple 'technology transfer' from a technological center to a periphery, with the first Greek users being passive recipients of the transferred technology. The research presented in this chapter comes to challenge this assumption. Through retrieving the extensive and skilled work required to domesticate (localize, adjust) a supposedly 'universal machine', I will move on to argue that the Greek users were in fact active agents of scientific-technological change in general and computing science and technology in particular.[23]

The minicomputers imported to Greece would have been of limited use because some basic prerequisites for working with them successfully were rather absent. Most importantly, as argued in 'Universal Machines vs. National Languages: Computerization and Production of New Localities', the first Greeks to purchase an imported minicomputer run into trouble when they wanted to use the characters of the Greek alphabet all the way from typing to printing. For

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anglophone European country', 26th International Congress of History of Science and Technology: *Giants and Dwarfs in Science, Technology and Medicine*, Prague, 25-31 July. Κεχριμπάρης *«Πρόοδος του Πολιτισμού*. For a pioneering history of mainframe computer advertisements and the way they sought to shape the users of computers, see Aspray, William and Beaver, Donald D. (1986) 'Marketing the monster: Advertising Computer Technology, *IEEE Annals of the History of Computing*, 8(2): 127-143.

[23] For an influential historiographical call to the active agency of peripheral agents in science, see Gavroglu, Kostas, Patiniotis, Manolis, Papanelopoulou, Faidra, Simoes, Ana, Carneiro Ana, Diogo, Maria Paula, Sanchez, Jose Ramon Bertomeu, Belmar, Antonio Garcia and Nieto-Galan, Agusti (2008) "Science and technology in the European periphery: Some historiographical reflections", *History of Science*, 46(2):153–175. For a similar argument in regards to technology, see Arapostathis, Stathis and Tympas, Aristotle (2017) "The history of technology in modern Greece from the Nineteenth century to the present day", *History of Technology*, 33(1): 1-17.

about two decades, the support of the Greek language was not a simple issue. The Greek users had to buy extra software or, more frequently, produce themselves software that did not exist, in order to be able to accommodate cases in which the use of their own language was necessary. The Greek case is highly exemplary regarding the study of the earlier history of language-related issues in many other non-anglophone computing contexts.[24]

The early Greek minicomputer users had to deal with the absence of any organized technical support. Given that the Greek minicomputer market was rather small, the international manufacturers usually "offered nothing" (in the words of a pioneer Greek user). In 'Legal pirates ltd: home computer cultures in early 1980s Greece', Theodore Lekkas pointed to the positive role of software piracy in the diffusion of minicomputers in Greece. According to his argument, the practices of software hacking –from 'breaking' a program code to copying and distributing it for free or for an affordable amount of money– were standard in this period. Those involved were proud to be called 'hackers', and considered hacking a service and an honor. Against assuming anachronistically that 1980s hacking was an immoral and illegal practice, Lekkas suggests that computer piracy "was the basic prerequisite of the diffusion of computers in Greece".[25]

Producing the missing software through sharing practices resulted in the formation of a community of Greek minicomputer users who had a shared enthusiasm about computing technology. This community grew together with a series of initiatives and institutions. In "Computer Technology Periodicals and The Circulation of Knowledge", Lekkas provides a mapping of no less than 27 computing-related periodical publications from the 1980s that ushered in the establishment of minicomputer-based electronic computing in Greece. Through special issues and dedicated columns, they were offering instructions on how to program and address issues (like the ones related to the use of the Greek alphabet), while providing updates on international news, especially about new hardware and software. In the absence, at the time, of institutions of advanced

[24] Tympas Aristotle, Tsaglioti Foteini and Lekkas Theodore (2008) 'Universal Machines vs. national languages: Computerization as production of new localities', in Reiner Anderl, Bruno Arich-Gerz and Rudi Schmiede (editors), *Proceedings of the Conference 'Technologies of Globalization'*, Darmstadt, Germany, 223-234.

[25] Lekkas, Theodore (2014) 'Legal Pirates Ltd: Home Computing Cultures in Early 1980s Greece', in G. Alberts and R. Oldenziel (eds) *Hacking Europe: From Computer Cultures to Demoscenes*, New York, New York: Springer, 73-103.

or other training in computing science and technology, these periodicals served, perhaps, as the most important medium for the promotion of minicomputers and their adaptation to concrete use in Greece.[26]

The Greek community of minicomputer users also grew through and in virtue of activities afforded by the availability of a multitude of computer stores, most of them of a small or medium size. In 'Legal Pirates Ltd: Home computer cultures in early 1980s Greece', Lekkas argues that these were much more than simple merchant stores. It was through them that Greeks found the support that they could not receive from major international vendors. A user could count on them for repairing, maintaining and upgrading a computer, for usable and affordable software, for training seminars, and for a whole range of supporting activities, some of which were carried out by stretching the limits of the law. This contributed substantially to bringing electronic minicomputing within the reach of the many.[27]

Also important were the computer clubs that also reach back to the 1980s. In "'A club for all the Greeks': Home micros computer clubs between magazines and stores', we showed that users could count on computer clubs to practice programming, to experiment with new software and to try, test and compare new hardware. Some clubs frequently organized seminars on computing, courses on new programming languages, and trainings to familiarize the users with the workings of computing hardware.[28]

The members of this community were predominantly, if not exclusively, males, usually young. Yet, it would be wrong to conclude that computing had no

[26] See Lekkas, Theodore and Tympas, Aristotle (2020) "Global Machines and Local Magazines in 1980s Greece: The exemplary Case of the Pixel Magazine", *Wider Screen*, 2-3 (http://widerscreen.fi/numerot/2020-2-3/global-machines-and-local-magazines-in-1980s-greece-the-exemplary-case-of-the-pixel-magazine/) and Lekkas, Theodore (2017) "Computer Technology Periodicals and the Circulation of Knowledge about the Personal Computer", *History of Technology*, 33(1):229–251. For an early historiographical call to pay attention to the role of these periodicals in Greece, see Tympas, Aristotle (2003) 'One Global Machine, Many Local Journals: The Proliferation of a Nation-specific Press in Electronic Computing in the Case of Greece', Annual Meeting of the Society for the History of Technology, Atlanta, Georgia, 16-19 October.

[27] Lekkas 'Legal Pirates Ltd'.

[28] Lekkas, Theodore and Tympas Aristotle (2019) '"A club for all the Greeks': Home Micros Computer Clubs between Magazines and Stores", *Zeitschrift Geschichte und Informatik / Histoire et Informatique,* 20: 103-125.

space for women in Greece. On the contrary, women were invited to work with minicomputers. Following, however, in the pattern that we noticed in the history of electronic mainframe computers, they were presented as capable only of jobs considered inferior and, therefore, deserving a lower salary. In 'Constructing Gender and Technology in Advertising Images: Feminine and Masculine Computer Parts', a chapter hosted in an IEEE volume on the gender-computing relationship, we presented a first round of findings of research based on hundreds of computing and telecommunications advertisements in Greek periodicals from the period of the minicomputer. This research retrieved a pattern of associating the feminine with the parts of the computer that had to do with data input and output, from the keyboard to the printer. A closer look further showed that men were usually holding a phone or using a computer mouse, thereby being in control of the analog side of technology, whereas women were controlled by the digital keyboard and the printer. Last but not least, the habitual displaying of a feminine face in advertisements that featured a computer screen contrasted with the black-boxing of the processors and the other invisible computer parts that were displayed as belonging to the domain of masculine mind.[29]

Hara Konsta's doctoral dissertation came to confirm that this pattern in Greek computing advertisements reaches back to the history of the electronic computer mainframes and all the mechanical, electrical and electromechanical computing artifacts of the period before the 1980s. And, also, that his pattern made it to the 2010s.[30] Konsta's dissertation emphasized the construction of the imaginary about computers in Greece. Alexandros Panagopoulos' doctoral dissertation starts from the other end of the spectrum. Focusing on the real work involved in electronic technology in Greece, he shows that a gendered division of labor, tacitly promoted by this imaginary, has frequently been the canon in concrete work settings. Typical here is the case of the invisible labor that has

[29] Tympas Aristotle, Konsta Hara, Lekkas Theodore and Karas Serkan (2010) 'Constructing Gender and Technology in Advertising Images', in Thomas Misa (editor), *Gender Codes: women and men in the computing professions*, Hoboken, New Jersey: IEEE Press, 187-209.

[30] Κώνστα, Χαρά (2013) *Γυναίκες στην Περιφέρεια της Πληροφορικής: Αθέατοι Μηχανισμοί Κατασκευής Κοινωνικού Φύλου*, Διδακτορική Διατριβή, ΕΚΠΑ, Αθήνα.

made possible the drive for the digitalization of all kinds of archival collections of printed media.[31]

IV. Conclusion: Emerging Technologies, Resurfacing Challenges

The third period, that of the massive networking of computers, which exemplifies the inseparability of electronic computing and telecommunications, started with the internet and the web before giving us a universe of social media, most notably facebook. Considering that these computing networks, by now turned into computing and telecommunications platforms, are changing every day before us, it may be safer to try to make sense of them through sociology rather than history. I may then briefly conclude with two recent studies that blend sociology and history, one on computing and the other on telecommunications. I singled them out because they help us to check where things are in regards to some of the most important patterns that this chapter sought to map.

The first study, undertaken by Grigoris Grigoriadis in the context of the Graduate Program 'History and Philosophy of Science and Technology', regards the transition from analog to digital media in 2010s Greece. This study is inspired by a historiography that contrasts the hegemonic rhetoric regarding the technical-inherent-essentialist superiority of the digital over the analog with the reality of socially situated experiences with the digital. It juxtaposes the definition of the digital by its business, media and expert promoters with the challenges to this definition during the social use of the digital. The study focuses on experiences with the digital at some of Greece's geographical and social far ends: remote mountain and island locations. The emphasis is placed on the history of the so called 'transition' from the analog to the digital television as this was experienced by the Greeks who still try to live at these far ends – the few in this country left to resist the tendency to move from a remote mountain or island village to a town, from a town to a city, from a city to a metropolis. This is why the empirical material of the study comes mostly from a wave of protests by

[31] For a presentation of some findings from this dissertation, see Panagopoulos, Alexandros (2018) 'Invisible Labor During the Digitization of the Newspaper Archive of the Greek Parliament Library, 2004-201', Conference 'The Production of Information Technologies, Media Markets, and Labour in the Twentieth Century', Museum der Arbeit, Hamburg, Germany, 12-14 April.

mayors from these remote Greek mountain and island locations. The study zooms in the contrast between the sharpness of the digital television signal at central locations, where one could actually receive it, and the total loss of television signal at peripheral locations – the latter described by the aforementioned mayors as 'darkness'. According to the argument and on the grounds of this contrast, digitalization may be best defined as meaning sharpness in the center but darkness at the periphery, therefore amounting to increase in centralization but, also, corresponding increase of peripherization of some of the areas that have historically defined the uniqueness of the Greek natural and social geography.[32]

The second study was undertaken by Natasa (Anastasia) Stoli in the context of the Graduate Program 'Science, Technology, Society—Science and Technology Studies'. This study focused on the ongoing drive for datafication and the associated emergence of big data. Following in the approach of Kechrimparis' (mainframes) and Konsta's (minicomputers) studies, Stoli has studied the images accompanied articles on big data imagery in newspapers in Greece, and, for comparative purposes, the United Kingdom. Her findings point to a striking continuity regarding, notably, the gendered presentation of big data and the accompanying technologies, from algorithms to artificial intelligence, thus, confirming, that the newest technology around does not necessarily come as a break from the oldest of social habits.[33]

The resurfacing of social challenges alongside the emergence of new technologies of computing and telecommunications makes the need for professional research (and education) on the history of these technologies even more urgent. In this chapter I tried to respond to this urgency by placing a synthetic reading of contributions to the history of computing and telecommunications in Greece under a historical periodization that seeks to align

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[32] Γρηγοριάδης, Γρηγόρης (2020) *Σχέση Αναλογικού-Ψηφιακού στην περίπτωση της τηλεόρασης: αναδεικνύοντας συσχετισμούς τεχνικών και κοινωνικών σχέσεων*, Διπλωματική Εργασία, ΕΚΠΑ, Αθήνα. See, also, *Grigoriadis, Grigoris and Tympas, Aristotle (2019) 'On technological darkness: Experiencing the digital at the far ends of Europe', The 9th 'Tensions of Europe' Conference, Luxemburg, June.*

[33] Stoli, Anastasia (2019) *Picturing Big Data in media: an STS-based approach*, Master Thesis, EKPA, Athens. On the complex relationship between technological and social progress, classic is the argument by MIT Emeritus Professor Marx, Leo (1987) "Does Improved Technology Mean Progress?", *Technology Review*, January: 33-41.

the Greek with the international historiography of computing. Indispensable as such alignment may be for those working on the history of computing in the national case under consideration (Greece), I hope it has become apparent how much it has to offer from an international perspective.

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