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Computing in Our Style: Information Technology and Juche Ideology in Cold War North Korea

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Abstract

In September 1961, scientists from the North Korean Academy of Sciences unveiled their country's first digital computer. The national press praised the scientists' machine, both for its potential benefits to the national economy and for having been built with domestic materials and without foreign assistance. From a critical discussion of this narrative, the present article analyzes the physical and discursive construction of this "national computer", tracing its origins to Soviet designs, the "self-reliant" production of semi-conductors from industrial byproducts and the percolation of the concept of *juche* in scientific discourse in the late 1950's. Highlighting a number of little known technological exchanges between the DPRK and the world, it moves to show how this relationship between technology imports and the state's rhetoric of self-reliance continued to influence the economy and culture of the DPRK throughout the Cold War.

Keywords: Cold War, COMECON, computer technology, *juche*, North Korea, post-colonialism, USSR

Introduction

The Korean War's influence on the history of computing is a well-documented fact. The crucial importance of aerial warfare—from bombers to missiles—and cryptoanalysis during the War created a renewed interest and demand for computing equipment in the defense sector.[1] The US military's large public contracts and research grants provided a flow of capital to the American computing industry, creating the first generation of professional programmers and kickstarting commercial computer production.[2] But, in contrast to the numerous studies on the American side, there has been little research on the development of computing after the war in Korea itself, whether North or South. In the Democratic People's Republic of Korea (DPRK), the creation of the State Academy of Sciences towards the end of the war, the influence of Soviet cybernetics, and the economic management methods of the post-war reconstruction pushed the country to develop an early interest in computing, eventually allowing it to produce domestically a variety of machines throughout the Cold War.[3]

The history of computing has certainly already come a long way since Corinna Schlombs' call for an "international history of computing" that would move away from "American-centered" perspectives.[4] The history of computing in the USSR has been the site of renewed scholarly and popular attention beyond Cold War dichotomies and has even extended to the socialist world outside of the Soviet realm with Allende's Chile and China.[5] In the meantime, the work of Warwick Anderson and, more recently, the concept of post-colonial computing, as developed in the work of Kavita Philip, Paul Dourish, and Lilly Irani, have offered methodological frameworks to question and understand the development of computing across the globe.[6] The present article contributes to this trend of scholarship by highlighting how post-coloniality, cultural factors, and political ideology contributed to the development of the North Korean computer industry. It also seeks to offer an alternative perspective to current research on technology transfers, moving away from technology as "imported magic" and diffusionist models of knowledge,[7] but also beyond a still oft-employed bilateral model of transfer (the source and its adaptor) by providing

a more fragmented, pluralistic perspective and showing how North Korean scientists and engineers mobilized networks of diasporic communities, trade companies and engineers from Europe, the USSR, China, Japan, and South-East Asia to build a domestic computing sector.

The lack of scholarship on North Korean computing may seem natural for what could be, after all, a niche subject in a small country. And yet the topic is the subject of frequent press coverage and continues to be an ongoing issue in intelligence and security circles. As a cursory glance at press headlines will reveal, its treatment is marked by the predominance of what Hazel Smith has termed the "securitization paradigm"—the subsumption of all DPRK-related issues, whether economic, cultural, or scientific, to a military-based analysis—leaving little room for alternative narratives and analyses to emerge.[8] Nonetheless, as this paper argues, there is much that a historical perspective on the development of computing in North Korea can bring to our understanding of the country, beyond the assessment of its cyberwarfare capabilities.

In North Korea, computers, as technological artifacts, have functioned as both symbols and promises of ideology. Having appeared at approximately the same time as *juche* [주체], the state's now-official ideology, computers were meant to illustrate that ideology's present progress and to guarantee its future complete realization. While the first aspect merely highlights the spectacular, propagandistic dimension of technological achievements, the second one shows *juche* in a different light: not as the clear set of tenets and confident, programmatic slogans of basic propaganda but as an ideology in search of technology. A loose assemblage of principles is less confident in its own vision than in technology's ability to realize it. Consequently, while this paper analyzes *juche*, it attempts to do so pragmatically, in context, from its inception to its protean discursive manifestations throughout the Cold War as a signifier for self-reliance, national pride and the search for a Korean way—*uri-sik* [우리식] or "our style." Finally, it seeks to highlight how computing interacted with ideology, showing that while the latter certainly shaped the former, the promises of digitization and automation also expanded the discursive horizon of state ideology.

Scientific Nationalism, Self-reliance and North Korea's First Computer

On September 7, 1961, the front page of the *Rodong Sinmun*, the official newspaper of the North Korean Workers' Party (hereafter KWP), praised on its front page the construction of "an all-purpose electronic computer [만능 전자 계산기]," first unveiled at the 4th Congress of the KWP.[9] The article carried a picture of the computer, a rather small machine fitting in a couple of cabinets and flanked by a teletype.[10] Lined up below were the portraits of ten of the researchers and technicians from the National Academy of Sciences who built the digital computer "with their own strength [자신의 힘으로]"—as, according to the author, parts were difficult to import and "foreign books" provided no information on how to build a computer.

Yet the journalist's assessment of the availability of computer technology does not quite paint the full picture. Over the preceding years, the Soviet Union, along with other socialist states such as Czechoslovakia and East Germany, had made significant progress in computer science and started disseminating technology and hardware across the socialist world, including outside of the COMECON to China.[11] Why, then, would a country still re-industrializing and recovering from the widespread destruction of the Korean War forego the "fraternal assistance" of other socialist nations and devote significant resources to the construction of a domestic computer?[12] Or was the computer really just an import from overseas, masquerading as a national scientific achievement?

The technical characteristics of the computer given by their creators allow us to address this last question. From its two-memory operand instruction set to its 1024-word ferrite-core magnetic memory and compact build, the North Korean computer, later dubbed the "9.11" computer, is extremely similar to the Soviet M-3 model whose blueprints had circulated and been replicated in other socialist countries in the late 1950s.[13] Scientific papers, including some published by one of the computer's leading engineers, Hŏ Kŏn, shows that North Korean scientists had been studying the architecture of Soviet computers such as the STRELA for a few years.[14] While how they managed to obtain their reference materials, directly from the Soviet Union or indirectly through

China, is unclear—the genealogy of the computer they built is fairly obvious.[15]

The fact that North Korean scientists used the M-3's blueprints certainly attenuates the claim that the new computer was a national production, but it does not entirely invalidate them. Indeed, actually building the computer required significant expertise as well as the ability to produce and assemble a number of indispensable components: while at least all the COMECON countries and the Soviet republics could technically request the blueprints, only a few succeeded in building the machine. Of course, the USSR could also provide direct assistance. In the case of China, for instance, the M-3's original designer—George Lopato—was dispatched on-site to help Chinese scientists replicate the computer. And yet looking at Russian archival records of DPRK-USSR scientific exchanges, the researcher cannot see that the North Korean scientists received any initial form of support: the training of North Korean scientists in computer science and the dispatching of Soviet computer specialists to the DPRK would only start the following year, in 1962.[16] Perhaps due to this, the North Koreans also had to adapt the original blueprints to the parts and resources available to them as well as the projected uses of the computer—for instance, by limiting the amount of vacuum tubes or extending the instruction set.[17] Of course some components, such as the teletype, could hardly have been produced locally and must have been sourced from overseas, but other parts—from the transistors to the capacitators and ferrite magnetic—were clearly manufactured directly in North Korea.[18] This, in turn, hints at the fact that the production of the computer had not been just opportunistic, triggered by the sudden obtention of Soviet blueprints, but the product of a longer foray into electronics that had allowed the country to develop the basic production capacities for semi-transistors and other components.

Understanding why the North Korean press sought to conceal the foreign roots of the design of the computer and finding out how the scientists managed to build it using local know-how and materials requires one to look further into the ideological context of the period. The first thing that comes to mind is of course the famous 1955 speech by Kim Il-sung, *On Eliminating Dogmatism and Formalism and Establishing*

Juche in Ideological Work. The speech introduced the term *juche*, which would subsequently become the moniker of the Party's "monolithic ideology," calling for North Korea to find its own political and economic path, distinct from the Soviet or Chinese models.[19] Such an explanation fits nicely with North Korean historiography which dates the beginning of North Korea's interest in building a "self-reliant" nation to this speech. One must, however, be wary, as Andre Schmid notes, of reproducing "key features of North Korean propaganda within [one's] own analytical framework."[20] We know that Kim's speech did not mark a break in USSR-DPRK relations, whether political or scientific, nor did it mark a radical turn away from Marxism-Leninism and towards nationalism.[21] And it would be another few years before the term became a mainstream political buzzword, employed interchangeably with self-reliance [자립], self-determination [자주], and self-defense [자위].[22]

The roots of the emphasis on national autonomy in science can be traced back much earlier, to the Liberation period. The North had inherited the remains of Japan's colonial heavy industry, including one of the largest factories in the world in Hamhŭng. Managing and operating this vestigial infrastructure, however, quickly proved problematic owing to the lack of a qualified workforce as less than a dozen people with a university degree in science could be found in the North.[23] To solve this situation, the Provisional People's Committee for North Korea put forth a policy to actively recruit ethnic Korean scientists abroad in Seoul, Japan, or China, to mobilize Japanese and other foreign technicians residing in North Korea and to foster the education and training of domestic scientists.[24] While economic development was the stated goal of the People's Committee, the rhetoric used to create popular enthusiasm for scientific education made use of the country's colonial past. In popular science magazines and in novels such as Lee Song-wŏn's *Female Driver* or Chŏn Mu-gil's *Slate Factory*, science was seen as something that the Japanese colonizer had consciously and systematically deprived the Koreans of, by hampering their access to education or by simply refusing to give them advanced technical training in the workplace. Regardless of the veracity of this narrative, science became associated with the post-Liberation project of exorcising the colonial past: creating a national

science was overcoming the shame and trauma of colonization.[25]

Yet, while the political rhetoric of the post-Liberation period politicized science and emphasized the need to develop it domestically, there were no claims of the excellence of North Korean science, no attempts to rehabilitate pre-modern scientific knowledge (which was instead dismissed as mere superstition) and no use of science to emphasize the uniqueness of the Korean nation.[26] Rather science was still seen as universal and, more importantly, as something that had to be imported from outside, as exemplified by the slogan "Let's learn from the Soviet Union [소련을 향하여 배우자]" and the efforts to translate foreign scientific texts into Korean.

The Korean War and its aftermath marked the beginning of a shift away from this vision of science as something to be brought in from the outside. Foreign, and more specifically Soviet, science did remain an important part of North Korean scientific practice and culture, but the domestic scientific field grew large enough for the exaltation of a national science to become not only a possibility, but increasingly a fixture of the rhetoric of the state. The establishment, in 1952, of the National Academy of Science had already given the country a centralized scientific institution and the post-war years saw an increase in visual and textual representations of North Korean scientists.[27] By the end of the 1950s and early 1960s, scientists such as Kim Pong-han, Han Hong-sik and Ri Sŭng-gi were honored as national heroes, while illustrious premodern figures from traditional medicine and science were rediscovered and praised in books with titles such as *Our Country's Inventors* or *The Pride of Our Ancestors*.[28] The historian of science Ch'ae T'ae-sŏng exhumed what he considered a long and unique tradition of "national mathematics" from cultural artifacts of the ancient Koguryŏ era, the mathematical culture of the Koryŏ kingdom (918–1392) and the writings of the nineteenth-century scholar Nam Pyŏng-gil.[29] A mindset of scientific exceptionalism started to develop, which set apart "Korean science" from general scientific practice. This singularization and nationalization of science, in turn, explains why the *Rodong Sinmun* journalists so downplayed the role of foreign knowledge in their presentation of the computer.

But the war also brought about another major transformation in the

North Korean conception of science. The shortages caused by the war lingered long afterward and boosted research into ersatz products. Many of the most publicized inventions of the postwar period, such as Ri Sŭng-gi's Vinalon fiber, Chu Chong-myŏng's ferrous coke, or Han Hong-sik's coal gasification process, offered alternatives to necessary commodities that could be produced using local resources.[30] Along with the national pride they could call forth, these innovations also symbolized the "Korean way" of *juche*: they made use of abundantly available local materials. In this way, they functioned to demonstrate a Korean specificity and contributed to national self-reliance. In fact, while self-reliance was not yet commonplace in the political sphere, terms such as the "*juche* of science [과학의 주체]," "science with *juche*ness [주체성 있는 과학]," or "establishing *juche* [주체를 확립]," each of which expressed science's contribution to national autonomy, started appearing frequently in scientific publications in the late 1950s and early 1960s—prompting the South Korean historian of science Kim Kŭn-bae to note that it was in the scientific community, rather than in politics, that *juche* was first expressedly defined.[31]

The advent of "*juche* science" and the emphasis on self-reliance was instrumental in the development of computing in North Korea—and not merely because of the national pride associated with the local production of an advanced technological device. At the end of the 1950s, Kang Hoŭng, a young researcher associated with the Mathematics and Physics department of the Korean Academy of Sciences, was dispatched to the smeltery of the industrial city of Nampo to study its waste products. Kang's research project was exemplary of the new *juche* way of doing science: he focused on a concrete, practical and local issue that had the potential to increase the country's self-reliance by finding uses for the materials expunged from metallic ores during the smelting process. One of the materials was germanium, an ore abundant in North Korean soil and found in large quantities among the by-products of the zinc ore smelted at Nampo. Germanium also happened to be the most popular semi-conductor material at the time, before silicon progressively replaced it in the 1960s. Kang was soon using germanium refined from the residues of the Nampo factory to build transistors and electronics devices. The *juche* character of his research brought him public exposure and political

support, enabling North Korea to push research into electronic and begin industrialization efforts—creating a domestic source of electronic components that could be used to build a computer.[32]

It would be easy to dismiss North Korea's first foray into computing as a mere political show, perfectly timed to be unveiled at a KWP Congress. Yet the computer was more than that. It mobilized some of the local talent, knowledge, and resources that the country had been developing for years. The computer also answered a real need: under the influence of the popularity of cybernetics in the Soviet Union, North Korean planners, economists, and accountants had increasingly adopted statistics, linear programming, and other "mathematical management [수리 운영학]" methods that required significant computing power.[33] The computer, it was thought, would "be giving to economists and planners a powerful weapon to accurately describe and quickly analyze the quantitative aspects of economic processes and phenomena."[34]

It might likewise be tempting to completely dismiss the North Korean claims of self-reliance by pointing out the North Korean engineers' debt towards Soviet sources. But only in propaganda does self-reliance ever purport to be absolute.[35] In practice, as the example of germanium and the semi-conductor industry shows, self-reliance came from more limited initiatives that reduced the overall dependence on foreign imports (material or intellectual). These innovations illustrated a "Korean way" of doing things, either by taking advantage of local resources or, more often, simply by virtue of having been done, if only partially, by Koreans on Korean soil. In science, as in politics, the fact that North Korea sought to pursue its own way did not preclude it from maintaining relations and exchanges with the USSR. There was, for instance, no contradiction between the North Korean press rooting for Soviet science in the space race while simultaneously praising the discoveries of Korean scientists. Consequently, the nation-wide emphasis on self-reliance prompted by the adoption of *juche* as the sole state ideology in 1967 did not necessarily make the "*juche* science" of the following years more autarkic. To the contrary, in the field of computing, the quest for self-reliance was very much oriented towards the outside.

Importing Self-Reliance

In December 1977, an anonymous representative of a French computer firm arrived at the American embassy in Paris. The man alerted the embassy's export development officer of a possible plan by Prakla-Seismos—a geomechanics company from West Germany—to export a U.S.-built PDP-11 computer to the DPRK through a subsidiary in Egypt. The North Koreans eventually planned to use the machine for seismic applications for the petroleum industry. Regardless of its planned end use, the sale of a computer equipped with a state-of-the-art array processor would have been in violation of the Coordinating Committee for Multilateral Export Controls (CoCom) which laid out strict hardware limits for the export of electronic computers to socialist countries.[36] Yet the man's motive for this denunciation was not the fear of advanced technology from the free world falling into the wrong hands. Rather, he hoped to push the US Department of Commerce to intervene so that once the Germans had failed to sell the computer to North Korea, his firm, believed by some to be the Compagnie Internationale pour l'Informatique (CII)-Honeywell, would obtain the contract instead for one of its own computers.[37]

The incident illustrates the difficult paths the North Koreans had to tread sometimes in order to acquire foreign technology amidst Cold War-era export controls. But it also takes us out of the socialist sphere and into the world of international competition between capitalistic corporations. Fifteen years after having built their first computer based on Soviet technology, why did the North Koreans turn their eyes to Western Europe? Why the switch from a strategy of local reproduction to one of outside acquisition? And what could explain the willingness (and competitiveness) of Western European sellers in dealing with the DPRK?

The "9.11" computer unveiled in 1961 was put to use to help with the management of a few factories and farms but was never serially produced.[38] The Academy of Sciences and certain universities would produce a few other models (both analog and digital) but never on an industrial scale, eventually prompting the ire of Kim Il-sung who lamented the scientists' inability to industrialize computer production despite the fact that cybernetics was one of the most critical themes

intended to ensure the country's development.[39] If socialism was statistics, as Kim emphasized, paraphrasing Lenin, the process of collecting, compiling, transmitting, and processing data to output statistical indicators and previsions had to be computerized for the "people's economy [인민 경제]" to be run efficiently.[40] In the 1960s, those processes were still done by hand, or at best with an abacus, by the many data analysts, *t'ongyewŏn* [통계원], appointed in each of the country's production units and in the various regional statistical offices.[41] The process was slow, rife with errors (data analysts were often regular workers with little to no formal training in mathematics) and inherently limited by the low volume of inputs that individual human operators could process.[42] The Workers' Party planned to computerize the national economy, aiming to equip the most important regional statistical bureaus with data collecting computers, progressively expanding to smaller regional and municipal offices before directly connecting them to factories and businesses. A pilot project was launched between the Central Statistics Bureau and a Pyongyang textile factory, but equipping the other bureaus would have required at least 10,000 machines. Still more would be needed to adequately supply all the other planning and financial institutions.[43] As in many of the other socialist countries at the time, the DPRK policy planners thought that cybernetics and computers were indispensable in order to solve the "economic calculation problem"—that immensely complex set of computations required to model and plan a whole socialist economy.[44] By guaranteeing a reliable stream of data and offering the possibility of accurately processing them, the computer was perceived as the key that would turn economic planning from informed predictions to scientific forecasts—and allow the people's economy to strive forward and eventually to emancipate itself from foreign capital.

What, then, was to be done? Until computers could be locally produced, the solution adopted was to draw on foreign exchange reserves and to purchase computers abroad.[45] The Soviet Union may have seemed like the natural source, but although many North Korean engineers were trained in Moscow, visited computer centers in Soviet republics such as Latvia, and imported MINSK computers, the bulk of

their purchases came from the socialist states outside of the USSR.[46] For example, Poland started selling computers from its ODRA line in the early 1970s, followed by Romania, Bulgaria (which would eventually supply whole computer centers), and East Germany with its Robotron line.[47] East Germany also served, through the North Korean embassy in Berlin, as a hub for repatriating computers and electronics obtained in the West.[48]

Indeed, Western capitalist countries also accounted for a significant portion of North Korea's computer imports during the Cold War. The restrictions of the COCOM framework proved challenging to free trade, but firms could come up with creative ways to bypass them, by using subsidiaries in the Third World as in the aforementioned example, by formally changing the name of the model sold to that of an older or lesser known one, or by simply choosing not to report the trade at all, hoping it would go unnoticed.[49] Lobbying the US Department of Commerce for approval on an "exceptional basis" was another possibility, but COCOM restrictions only concerned state-of-the-art machines, meaning that regular computers could still be sold without restrictions.[50] France, for instance, supplied three T 2000/20 computers in 1971 through a Danish subsidiary of Télémécanique, eight refurbished Gamma-10 the same year through Honeywell-Bull, two IRIS-50 computers for 11 million francs ($9 millions in today's dollars) and a MITRA-15 micro-computer, along with consulting services and technical training in the DPRK and France in 1974.[51] More MITRA units and other models would be sold over the next couple of years by CII and Bull.[52] Other European countries such as Germany and Great Britain also closed deals with Pyongyang.[53]

This Western European willingness to sell to North Korea is not so surprising if one considers that the country's financial situation still looked relatively stable from the outside well into the 1970s.[54] The country represented a new market for European IT companies that were struggling to compete with American giants such as IBM.[55] While not considered as interesting as the Chinese or Soviet markets, the DPRK became a part, along with other countries such as Cuba, Poland or Egypt, of the expansion strategy of key European firms towards the East and global South.[56] The North Korean market had the additional

advantage of being under US embargo (therefore technically off-limits for American manufacturers) and was seen as still relatively free of Japanese competition.[57] European computer firms were helped in their endeavors by private trading companies that acted as intermediaries against a commission in order to facilitate sales and delivery to socialist countries.[58] They also benefited from governmental support, for instance in the form of credit insurance from public export credit agencies, as European governments were eager to become less technologically dependent on the United States by developing their national IT sectors.[59]

There is, of course, something paradoxical about North Korea's pursuit of national autonomy and its ramping up of imports. It is true that the large range of countries from which computers were sourced can indicate a conscious strategy to avoid relying upon any single supplier (although technical preferences and sheer happenstance may also have played a role). But the purchases were always a temporary solution: an injection of much-needed technology until the country could produce its own—even if that meant importing production capabilities too. By the 1970s, the North Korean government had indeed started to import turnkey factories to upgrade its industrial infrastructure and start producing goods it had hitherto imported.[60] Computers were not excluded from this import-substitution program. As North Korea sought to improve its commercial relations with Japan in the early 1970s, a delegation of Japanese PMs and businessmen visiting Pyongyang signed a trade agreement which included the import of a computer factory.[61] The agreement faltered, perhaps due to the Japanese government's unwillingness to provide loans for the plant orders and North Korea's inability to pay the debts it had already accrued.[62] But two years later, in 1974, a North Korean Import Corporation approached another supplier, the French-American company Honeywell-Bull, to purchase a "computer factory."[63] The North Koreans aimed to purchase licenses, services, and facilities to produce 100 large computers and 10,000 smaller office calculators per year. The factory and licenses would then allow North Korean engineers to produce local versions of Honeywell-Bull computers under a domestic brand name. The French salespeople invited to Pyongyang to discuss the scope of the project noted that

their interlocutors expected a "turnkey" factory, "as fully autonomous as possible" and thus capable of producing each individual computer part, from printed circuit boards and integrated circuits to the terminals themselves. The expected rate of return for the ambitious investment, however, was never discussed: the project was not motivated by profit but was first and foremost the product of "a desire to achieve industrial independence."

Conclusion: Technology as Imagery and Imaginary

The plans for this computer factory once again failed to materialize. The state's import substitution strategy was costly and its access to capital increasingly limited by rising debts and decreasing Soviet aid. Single prototypes continued to be built in the DPRK throughout the Cold War, but it would not be until the 1980s that North Korea established industrial production capabilities domestically, helped by easier access to components, UN assistance, and its relations with those Asian nations that took a laxer approach to export controls.[64] These ventures, plagued by reliability issues and low export prospects, did not prove sustainable, but they nonetheless displayed the established pattern of trying to increase the country's independence through outside assistance.

This dialectic of self-reliance and foreign import was never peculiar to North Korea: numerous leaders of developing nations, starting with South Korea's President Park Chung-hee, sought to realize the former through the latter with varying levels of success.[65] What set North Korea apart, however, is the relative disjunction between politics and economics. Computers were supposed to help the "people's economy" by improving planning and increasing productivity through automation. But, as the example of the discussions with Honeywell-Bull around the computer factory illustrate, the financial rationale for local production (*i.e.* the tradeoff relative to continued imports, the viability of the sector) was not discussed. The main issue was "industrial independence," regardless of the cost—an attitude often criticized even by Soviet observers.[66] Ultimately, the best definition of *juche* may lie in this absolute primacy of the political, rather than in the single theme of self-reliance. What

mattered indeed may not have been the self-reliance itself as much as the effort deployed to achieve it, the devotion to a political goal. In this context, technology worked under two modalities. As imagery, the construction of computers within North Korea illustrated a Korean way of doing things, compounded by the postcolonial prestige of having built a technologically advanced machine. Local computers functioned as an image (rather than as a true instance) of actualized ideology. But at the same time, computing technology was also the promise of the realization of the state's political promises. Computers would bring automated factories, precise planning and, along with it, national autonomy. They would operate as the black box between reality and utopia. This, in turn, may explain the success of techno-optimism and the exponentially growing presence of technology in popular discourse and imaginary in North Korea in the years following the end of the Cold War—a time when ideology seemed to become ever more distant from the possibility of realization.[67]

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Notes

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[10] The CDC-160, a contemporary "minicomputer" produced in the United States, took up 1 square meter and weighed 370kg. Small Soviet computers of the period (Minsk-1, M-3) needed 3 to 4 square meters.

[11] See "A Record of the Electronic Computer Industry in Our Country, Part 3 (1956–1983) [我国电子计算机工业大事记 (1956年–1983年)]," *China Historical Materials of Science and Technology* [中国科技史料] 6, no. 3 (1985): 53; Zhōu Xìn, "Thirty Years of Research of the Institute for Computer Science of the Chinese Academy of Sciences [中国科学院计算技术研究所科研工作三十年]," *Computer Research and Development* [计算机研究与发展] 23, no. 8 (1986): 1–15; Győző Kovács, "Hungarian Scientists in Information Technology," in *Reflections on the History of Computing: Preserving Memories and Sharing Stories*, ed. Arthur Tatnall (Berlin: Springer, 2012), 305; Antonin Svoboda, "From Mechanical Linkages to Electronic Computers: Recollections from Czechoslovakia," in *A History of Computing in*

the Twentieth Century, eds. N. Metropolis, J. Howlett and Gian-Carlo Rota (New York: Academic Press, 1980); and "Production of a New Computer in the Democratic Republic of Germany [독일민주주의 공화국에서 새로운 전자계산기 생산]," *Rodong Sinmun*, May 24, 1957. Like North Korea, China only held observer status in the COMECON. The distinction is significant as full members benefitted from the Sofia principle, according to which all members would make their technical knowledge available to one another for only a nominal charge. See Jozef M. Van Brabant, "Scientific Technological Co-operation—Its Organization," in *The Status of Civil Science in Eastern Europe*, ed. C. Sinclair (London: Kluwer Academic Publishers, 1989), 5–8.

[12] Most of North Korea's major cities, including the large industrial centers such as Hamhŭng, lost more than two third of their infrastructure and buildings to bombings. See Bruce Cumings, *The Korean War: A History* (New York: Modern Library, 2010), 159–60.

[13] Willis H. Ware, Wade B. Holland, and Andrew S. Kozak, eds., *Soviet Cybernetics Technology: III, Programming Elements of the BESM, STRELA, Ural, M-3, and Kiev Computers* (Santa Monica: The Rand Corporation, 1963); Alexander Nitusov, "M-3 Computer," Russian Virtual Computer Museum, accessed August 21, 2019, http://www.computer-museum.ru/english/m3.htm; Kovács, "Hungarian Scientists"; and Xìn, "Zhōngguó Kēxuéyuàn."

[14] Kŏn Hŏ, "Contemporary High-Speed All-Purpose Automatic Electronic Computer and Its Management [현대 고속도 만능 자동 전자 계산기와 그 운영]," *Bulletin of the Korean Academy of Sciences* [조선민주주의인민공화국 과학원통보], no. 4 (1961): 32–39; and Hong-sŏp Kim, "The Role of Calculating Machines."

[15] Soviet scientists who visited North Korea at the time and for years afterwards were unaware of the existence of the computer. On the other hand, Kim Il-sung had been shown computers, built based on Soviet designs, during a visit at Tsinghua University in Beijing in 1958. Russian State Archive of the Economy (RGAE 9480-9-1207), "Report on USSR-DPRK Scientific and Technical Cooperation for 1968 [Отчет о научно-техническом сотрудничестве между СССР и КНДР за 1968 год]" (1968), 8; and Il-sung Kim, "Speech Made in Front of the Staff of Kim Il-Sung University [김일성종합대학교 지원들 앞에서 한 연설]," speech on November 28, 1976, in *Works of Kim Il-Sung 31* [김일성저작집 31] (Pyongyang: Chosŏn Rodongdang Press [조선로동당출판사], 1986), 472.

[16] GARF, P9518 1 118 to P9518 1 123 and P9518 1 893 to P9518 1 894. "Correspondence with the Soviet Embassy in the Democratic People's Republic of Korea, Ministries and Other Soviet Central Institutions and Organizations on Cultural Relations between the USSR and the Democratic People's Republic of Korea [Переписка с Посольством СССР в Кореїскої Народно-Демократическої Республике, министерствами и другими тсентральными учрежденииами и организатсииами СССР о культурныкх свиазиакх СССР и Кореїскої Народно-Демократическої Республики]" (1959–1967).

[17] Such adaptations were also found in other localized replicas of the M-3. Kovács, "Hungarian Scientists," 305; Győző Kovács, "Short Stories from the History of the First Hungarian Computer (1957–1960)," in *History of Computing: Learning from the Past*, ed. Arthur Tatnall (Berlin, Heidelberg: Springer, 2010), 70–72.

[18] Hŏ, "Production of an All-Purpose"; Yŏng-ch'ang Kang, "To Strengthen and Widen the Results Obtained from the Fulfillment of the Policies of Our Party [우리당 과학정책관철에서의 성과와 그의 확대강화를 위하여]," *Bulletin of the Korean Academy of Sciences*, no. 2 (1962): 9.

[19] Il-sung Kim, "Some Advocate the Soviet Way and Others the Chinese, but Is It Not High Time to Work Out Our Own?," in *Works of Kim Il-Sung 9* [김일성 저작집 9] (Pyongyang: Chosŏn Rodongdang Press, 1984).

[20] Andre Schmid, "Historicizing North Korea: State Socialism, Population Mobility, and Cold War Historiography," *The American Historical Review* 123, no. 2 (2018): 440.

[21] Nationalism had already been well entrenched in political discourse since the Liberation. Brian Myers, "The Watershed That Wasn't: Re-Evaluating Kim Il Sung's 'Juche Speech' of 1955," *Acta Koreana* 9, no.1 (2006): 89–115.

[22] Dae-Sook Suh, *Kim Il Sung: The North Korean Leader* (New York: Columbia University Press, 1988), 307. In a 1965 speech, Kim Il-sung highlighted the four principles of *juche* as "juche (subjectivity) in ideology, self-determination in politics, self-reliance in economics, and self-defense in national security"; Il-sung Kim, "On the South Korean Revolution and the Construction of Socialism in Our Democratic People's Republic of Korea [조선민주주의인민공화국에서의 사회주의건설과 남조선혁명에 대하여]," in *Works of Kim Il-Sung 19* [김일성 저작집 19] (Pyongyang: Chosŏn Rodongdang Press, 1982), 306.

[23] Kŭn-bae Kim, *The Emergence of Human Capital Resources in Science and Technology in Modern Korea* [한국 근대 과학기술인력의 출현] (Seoul: Moonji Publishing, 2005), 510.

[24] See Il-sung Kim, "The Youth Organizations' Duty to Strengthen and Expand Democratic Abilities [민주역량을 확대강화하기 위한 민청단체들의 과업]," speech on September 29, 1946, in *Works of Kim Il-sung 2* [김일성 저작집 2] (Pyongyang: Chosŏn Rodongdang Press, 1979); Il-sung Kim, "On the Duty of Technicians and Scientists in the Present Time [현시기 과학자 기술자들의 임무에 대하여]," speech on October 18, 1946, in *Works of Kim Il-sung 2* (Pyongyang: Chosŏn Rodongdang Press, 1979); Myŏng-su Yun, *History of the Development of Science and Technology in North Korea* [조선과학기술발전사] (Pyongyang: Science Encyclopedia Comprehensive Publications [과학백과사전종합출판사], 1994); Kŭn-bae Kim, "Scientists and Technicians Gone North and the Establishment of the Hŭngnam University of Manufacturing [월북 과학기술자와 흥남공업대학의 설립]," *The Journal of Asiatic Studies* 40, no. 2 (1997); "Decision on Securing Technicians [기술자 확보에 관한 결정서]—Decision of the Provisional People's Committee for North Korea, August 17, 1946," in *Collection of Data for Research on North Korea* [북한 연구 자료집], ed. Chun-yŏp Kim (Seoul: Asiatic Research Institute Korea University, 2010).

[25] *Anthology of Popular Culture* 5 [군중문화총서 5] and *Short Stories Collection* [단편소설집]

(Pyongyang: Popular Culture Department of General Federation of Trade Unions of North Korea [북조선직업총동맹 군중문화부], 1949).

[26] I use these traits as representative of a nationalist discourse on science by borrowing some of the main examples given by Hiromi Mizuno in her discussion of the concept of scientific nationalism. Hiromi Mizuno, *Science for the Empire: Scientific Nationalism in Modern Japan* (Stanford: Stanford University Press, 2008).

[27] Benoit Berthelier, "Encountering the Alien: Alterity and Innovation in North Korean Science Fiction since 1945," *Journal of Korean Studies* 23, no. 2, (2018): 369–96.

[28] See Kŭn-bae Kim, "Change in the Science and Technology Policy of North Korea [북한 과학기술정책의 변천]," *Science and Technology Policy* 12, no. 2 (2002); *Our Country's Inventors* [우리나라의 발명가들] (Pyongyang: Democratic Youth Publishing House [민주청년출판사], 1956); *The Pride of our Ancestors* [우리 선조들의 자랑] (Pyongyang: National Publishing House [국립출판사], 1956); Sun-wŏn Hong, "Last Lifeline [마지막 생명선]," *New Generation* [새 세대] 1–7 (1965); and Il-sung Kim, "Conclusive Report on the Tasks of the Central Committee Done at the Third Congress of the Korean Worker's Party [조선로동당 제3차 대회에서 한 중앙위원회사업총화보고]," speech on April 23, 1956, in *Works of Kim Il-sung 10* [김일성 저작집 10] (Pyongyang: Chosŏn Rodongdang Press, 1980).

[29] "Brilliant Results Obtained in Scientific Research [과학연구사업에서 거둔 찬란한 성과]," *Taehak Sinmun*, October 1, 1956, 3; T'ae-sŏng Ch'ae, "On the 'Tae-yŏn' of Nam Pyŏng-gil [남병길의 대연에 대하여]," *Mathmatics and Physics* [수학과 물리] 3 (1962); "The Mathematical Culture of Koguryŏ [고구려의 수학 문화]," *Rodong Sinmun*, October 21, 1963; "Kang-bo and the Mathematical Culture of Koryŏ [고려의 수학 문화와 강보]," *Rodong Sinmun*, June 2, 1965.

[30] All were conferred the title of Labor Hero. Nam-un Paek, "Fourth Anniversary of the Creation of the Academy of Sciences [과학원 창립 4주년]," *Journal of the Korean Academy of Sciences* [조선민주주의인민공화국 과학원 학보], 4 (1956): 3–7; "The Republic Confers the Title of Labor Hero to the Comrades Ri Sŭng-gi, Chu Chŏng-myŏng and Han Hong-sik [원사 리승기, 주정명, 한홍식 동지들에게 공화국 노력 영웅 칭호 수여]," *Bulletin of the Korean Academy of Sciences*, no. 4 (1961): 55–56.

[31] See, for instance, "Conference of Science Professors [교원 과학 컨퍼런스 진행]," *Taehak Sinmun*, July 3, 1956, Namun Paek, "Report to Commemorate the Fifth Anniversary of the Creation of the Academy of Sciences [과학원 창립 5주년 기념 보고]," *Bulletin of the Korean Academy of Sciences*, no. 1, (1958): 16; "The Fruitful Realization of the Party's Scientific Policy in the Field of Maths and Physics [물리수학 부문에서 우리당 과학 정책의 성과적 실현]," *Mathmetics and Physics* 1 (1962): 1–6; Kŭn-bae Kim, "Ri Sŭng-gi's Science and North Korean Society [리승기의 과학과 북한 사회]," *Journal of the Society for Korean History of Science* 20, no. 1 (1998): 3–25.

[32] See "Research on Semiconductors [반도체에 대한 연구]," *Democratic Korea* [민주조선], December 1, 1962; Ho-ŭng Kang et al., "Research on the Manufacturing of Germanium [게르마늄 제조에 관한 연구]," *Bulletin of the Korean Academy of Sciences*, no. 3 (1960): 7–8; Kŭn-su Ryu, "Refining and Monocrystalline Manufacturing of Domestic Germanium [국내산

게르마늄의 정제 및 단결정 제조]," *Bulletin of the Korean Academy of Sciences*, no. 4 (1960): 32–33; *Semiconductor Triodes* [반도체 3극관] (Pyongyang: National Industrial Technology Books, 1958); Ho-ŭng Kang et al., "Making Semiconductor Devices from Germanium [게르마늄 반도체 소자의 제작]," *Bulletin of the Korean Academy of Sciences*, no. 2 (1961): 14–15; and Myŏng-su Yun, *History of the Development of Science and Technology in North Korea* [조선과학기술발전사] (Pyongyang: Science Encyclopedia Comprehensive Publications, 1994), 165–67.

[33] On the development of cybernetics in the USSR, see Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge: MIT Press, 2002). Signs of this change are visible in the numerous "charts" given out to local planners to help them collect adequate data and compute statistical indicators. Starting in the late 1950s, numerous translations of Soviet statistics handbooks and articles on mathematical management were also being published. See, for instance, "Synthetic Planning Chart for the Repairing Tasks [월보수작업 종합계획표]," *Economic Knowledge* [경제지식], no. 3 (1960), 12; Chong-nim Ri, "Statistical Quality Administration in Large Scale Production [대량생산에 있어서 통계적 품질관리]," *Science and Technology* [과학과 기술], no. 7 (1956): 6–14; and Myŏng-sul Chŏng, "The Use of Quantitative Management in the Work of Directing Production [경제사업 지도에서 수리 운영학의 리용]," *Economic Knowledge*, no. 7 (1961): 38–41.

[34] Hong-sŏp Kim, "Mathematical Methods in Economics [경제학에서의 수학적 제방법]," *Bulletin of the Korean Academy of Sciences*, no.1 (1961): 58–65; originally published in *Economic Science* [경제과학], no. 3 (1960).

[35] The concealing of Soviet influence is not limited to the case of computing. Soviet envoys complained about the North Koreans' lack of acknowledgment of Soviet scientific help in general. RGAE 9480-9-1207, "Отчет" (1968).

[36] "Consolidated List of Goods Subject to Security Export Control," I.L. 1565, *Trade and Industry* (April 30, 1976): 318–21.

[37] "Probable Diversion of Digital Equipment Computer to North Korea," Wikileaks Cable: 1977PARIS37202_c, dated December 21, 1977. American Embassy in Cairo, "Possible Diversion of Computer to North Korea," Wikileaks Cable: 1977CAIRO23116_c, dated December 28, 1977.

[38] "Lectures Held on the Way to Use Electronic Computers [전자 계산기의 사용법에 대한 강습회 진행]," *Bulletin of the Korean Academy of Sciences*, no. 2 (1962): 74–75; and Svetlana Georgievna Nam, *DPRK Education and Science under the Scientific and Technological Revolution* [Образование и наука КНДР в условиях научно-технической революции] (Moscow: Nauka, 1975), 55.

[39] "Production of an Analog All-Purpose Computer and a Vertical Compressor that Will Greatly Contribute to the Development of Science and the People's Economy [인민경제와 과학발전에 크게 기여할 수직형 치차 압착기 및 상사형 만능전자계산기를 제작]," *Democratic Korea*, December 4, 1962; In-ok Kwak, "Research on the Evolution and Analysis of the Real State of ICTs in North Korea [북한의 ICT 실태 분석 및 변화 과정에 대한 연구]," *North Korean*

Research Society Summer Conference [북한연구학회 하계학술회] (2015), 265; Il-sung Kim, "Speech in Front of the Staff of Kim Il-Sung University [김일성종합대학 교직원들 앞에서 한 연설]," speech on November 28, 1976, in *Works of Kim Il-sung 31* (Pyongyang: Chosŏn Rodongdang Press, 1986).

[40] Il-sung Kim, "A Few Problems Raised for the Improvement of the Task of Socialist Statistics [사회주의 통계사업을 개선하기 위하여 나서는 몇 가지 문제]," speech on October 21, 1969, in *Works of Kim Il-sung 23* [김일성 저작집 23]; and "On Establishing Revolutionary Order and Discipline in the Task of Economic Guidance [경제지도사업에서 혁명적규율과 질서를 세울데 대하여]," speech on October 21, 1968, in *Works of Kim Il-sung 24* [김일성 저작집 24] (Pyongyang: Chosŏn Rodongdang Press, 1983).

[41] Il-sung Kim, "On Improving the Campaign to Train Technical Talent [기술인재양성사업을 더 잘할데 대하여]," speech on March 9, 1960, in *Works of Kim Il-sung 14* [김일성 저작집 14] (Pyongyang: Chosŏn Rodongdang Press, 1981), 167.

[42] The difficulties faced by the newly appointed *t'ongyewŏn* when computing the increasingly complex statistics requested of them is described by the novelist Se-jung Yun in his novel *The Furnace is Breathing*. Se-jung Yun, *The Furnace is Breathing* [용광로는 숨쉰다] (Pyongyang: Korean Writers Alliance Press [조선작가동맹출판사], 1960), 208–09.

[43] Il-sung Kim, "A Few Problems Raised for the Improvement of the Task of Socialist Statistics."

[44] Yŏng-hui Chŏn, "Strengthening Statistical Work Is a Necessity for the Construction of Socialism, Communism [통계사업을 강화하는 것은 사회주의, 공산주의 건설의 필수적 요구]," *Workers* [근로자], no. 6 (1970): 64; Oskar Lange, "The Computer and the Market," in *Socialism, Capitalism and Economic Growth*, ed. C. H. Feinsteind (Cambridge: Cambridge University Press, 1969), 158–61; Slava Gerovitch, *From Newspeak to Cyberspeak: A History of Soviet Cybernetics* (Cambridge: MIT Press, 2002); and Eden Medina, *Cybernetic Revolutionaries.*

[45] Il-sung Kim, "A Few Problems Raised for the Improvement of the Task of Socialist Statistics," 419.

[46] "USSR EDP Exports," *Modern Data* 6 (1973): 11; RGAE 9480-9-2260, "Report on Scientific and Technical Cooperation between the USSR and the DPRK for 1971 [ОТЧЕТ о научно-техническом сотрудничестве между СССР и КНДР за 1971 год]"; RGAE 9480-9-1206, "Scroll: Areas in which the Soviet Side Will Accept Korean Specialists for Industrial and Technical Training [ПЕРЕЧЕНЬ: тем по которым Советская Сторона примет корейских специалистов для производственно-технического обучения]"; and "A82. Representatives of North Korea…," in *Soviet Cybernetics: Recent News Item Vol. 3, No. 3*, eds. Dorothy McDonald and Wade B. Holland (Santa Monica: The RAND Corporation, 1969), 65; originally published in *Nedelya*, February 23, 1969.

[47] Elwro, the ODRA's manufacturer, would go on to provide training and mainten ance to North Korea until the end of the Cold War. See Wilhelm Wojsznis, "History of Elwro Automation [HISTORIA AUTOMATYKI ELWRO]," accessed July 14, 2019, htt

ps://web.archive.org/web/20200124064808/https://www.historiainformatyki.pl/historia/skan.php?doc_id=1382&type=pdf&for_download=1; e-mail correspondence with M. Wilhelm Wojsznis and M. Jarosław Kutkowski, 2019–2020; and "Poland's Computer Exports," *Modern Data* (August 1973), 16. See also computer science articles using the ODRA published in the DPRK in the March 1972 issues of *Mathematics* [수학] 28–31 and *Bullet in of the Korean Academy of Sciences* 8–10, and Victor Petrov, "A Cyber-Socialism at Home and Abroad: Bulgarian Modernisation, Computers, and the World, 1967–1989," (PhD diss., Columbia University, 2017): 209. East Germany was also a destination of choice for the training of engineers and military personnel in computer science. Kim Yŏng-il, Kim Jŏng-il's younger brother, even started a PhD in Berlin's Humboldt University on the topic of distributed systems. STASI Archives [Bundesbeauftragte für die Unterlagen des Staatssicherheitsdienstes der ehemaligen Deutschen Demokratischen Republik], MfS—HA II 38258, BSTU 0117, 0129 & 0170. MfS—HA II 38766, BSTU 029, 040. Mats G. Lindquist, *Assignment Report RP/1981-1983/5/10.1/03, Establishment of Scientific and Technological Information Services for Economic and Social Development* (Paris: UNESCO, 1982), 4.

[48] MfS—HA II 38768, BSTU 0316-0318. MfS—HA II 38258, BSTU 0171.

[49] See Compagnie Internationale pour l'Informatique, "Communication—October 26, 1971. Proposition IRIS 50—North Korea from 25/10/71 [Communication—26 Octobre 1971. Proposition IRIS 50—COREE DU NORD Réf. DAI.DEE 2208 du 25/10/71]" (October 26, 1971). The same trick was used when exporting to other socialist nations. R. Gallois, "Communication—Cuba Issue [Communication—Affaire CUBA]," DJA—74/440/RG/mfb. December 19, 1974; and Archives Nationales du Monde du Travail—Bull: 2012 007 1129. See also "1. Pre-License Check: Video Data Systems Gmbh, Im Niederried 3, 6454 Bruchkoebel, Frg Subject: 2. Post-shipment Check: Video Data's Alleged Diversion of Data General Computer to North Korea," Wikileaks Cable: 1978STATE305670_d, dated December 3, 1978; and "German Integrated Circuits to North Korea - IL 1564," Wikileaks Cable: 1975STATE285595_b, dated December 4, 1975.

[50] D. A. Sackman, "CHB Sales to North Korea," February 1, 1974. Archives Nationales du Monde du Travail - Bull: 2012 007 461.

[51] See "Communication—September 6, 1973. Object: COCOM Documents—Leaflet AE from September 3, 1973 [Communication—6 septembre 1973. Objet: documents COCOM—Bordereau AE du 3 septembre 1973]," Archives Nationales du Monde du Travail—Bull: 2012 007 4039 Eastern Countries Information Bulletin; "Danish Computer Systems to North Korea—IL 1565," Wikileaks Cables: 1973OECDP21149_b, 1973OECDP21297_b, 1973STATE163068_b, 1973STATE148890_b, 1973OECDP20065_b, dated July 23–August 3, 1973; D. A. Sackman, "CHB Sales to North Korea," February 1, 1974, Archives Nationales du Monde du Travail—Bull: 2012 007 461; and "Contract regarding the sale of a MITRA-15 [Contrat concernant la vente d'un MITRA 15]," KS.20.9.74 (1974), "CII—KOREA SULBI-KS—K-131-74" (February 27, 1974), Archives Nationales du Monde du Travail—Bull: 2012 007 461.

[52] In-ok Kwak, "Research on the Evolution and Analysis of the Real State of ICTs in North Korea." E-mail correspondence with Michel Tisserand, representative of the Group for the development of commercial relations with the DPRK for French economic interest [Groupement d'Intérêt économique français pour le développement des relations commerciales avec la RPDC or GEFRACOR], May 2019. Spare parts and peripherals would also be purchased over the following years, including a floating-point operator and spare parts; "Contrat de vente opérateur virgule flottante avec Korea Equipment Import Corporation," KS.825 (December 12, 1977), "Contrat N. 920/77 KS" (December 20, 1977), Archives Nationales du Monde du Travail—Bull: 2012 007 462; and "Histoire de la Cii (3): 1972–1975—17 septembre 1974: conférence CII devant une soixantaine de journalistes de la grande presse et de la presse technique," Le site de la fédération des équipes Bull, accessed March 3, 2019, http://www.feb-patrimoine.com/projet/histoire_informatique/histoire_cii_1972-1975.htm.

[53] See "Probable Diversion of Digital Equipment Computer," "1. Pre-License Check," and "UK Digital Computers to North Korea—IL 1565," Wikileaks Cable: 1973STATE144677, dated July 23, 1973.

[54] Financial difficulties only became "critical" in the mid-1970s with the country defaulting on a large number of loans. Central Intelligence Agency Memorandum, "North Korean Payments Problem" (June 1975).

[55] North Korea had the additional advantage of being under US embargo, and therefore technically off-limits for American manufacturers.

[56] "Histoire de la Cii (3): 1972–1975"; Martin Campbell-Kelly, "ICL and the American Challenge: British Government Policies for the Computer Industry, 1945—1985," in *Technological Competitiveness: Contemporary and Historical Perspectives on Electrical, Electronics, and Computer Industries* (Piscataway, NJ: IEEE Press, 1993) 105–18; Jean Jacques Beauventre, "French IT: The Eastern Market Gamble [Informatique francaise: Le pari des marches de l'Est]," *Industries et Techniques* (June, 1971); "OBJECT: Manager for China and North Korea [OBJET: Responsable Chine et Coree du Nord]," (June, 1973), Archives Nationales du Monde du Travail—Bull: 2012 007 461.

[57] Magra France, "Exportation Department: Balance Sheet 1972 [Department Exportation: Bilan 1972]," (1972), personal archives of Mr. Jean-Claude Abeillon.

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