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*'Fancy Calculating Machine': Computers and planning in independent India**

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Abstract

In the middle of the twentieth century, statistician P. C. Mahalanobis strove to haul India into the computer age. Convinced that these machines were integral to the future of economic planning in India, he and the Indian Statistical Institute mounted a campaign to bring India its first computers. In the years following independence, Mahalanobis and the Indian Statistical Institute acquired significant influence in the Indian planning process—culminating in them effectively authoring India's Second Five-Year Plan (1956–61). The tale of the computer's journey to India demonstrates that the decision to centrally plan independent India's economy, and the resultant explosion of official statistics, provided the justification for the pursuit of computers. They potentially solved what was considered centralized planning's greatest puzzle: big data. Mahalanobis persuaded the Indian government of the need to import computers for the purposes of development, and then negotiated the import of these exorbitantly expensive machines during visits to Europe, the United States of America and the Soviet Union. Needless to say, the question of which country would provide India its first computers would ruffle Cold War feathers. This article brings together and identifies a link between the research activities of the Indian Statistical Institute, its deepening association with economic planning and the installation of India's earliest computers.

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Introduction

On a late February morning in 1959, a strapping young American engineer boarded a jet to flee Prague. Morton Nadler felt safe only when the Air India flight was airborne. He had been a de facto prisoner of the Czechoslovak government for years, barred from leaving the country—until now. During a refuelling halt in Athens, he considered for a moment walking up to the counter and declaring: 'I'm an American. I've just escaped from Prague. Take me to the American Embassy.' But the moment passed—as did the flicker of daring—and he swatted the idea away. Nadler was in the delicate position of being under suspicion by his country of birth, the United States of America (henceforth 'the United States'), and that of adopted citizenship, Czechoslovakia. The thought of what might befall those who vouched for him in Prague, and fear of the American government, nudged him aboard the connecting flight. After a day of taking in the sights at Bombay, Nadler proceeded to Calcutta. Travelling along a road that was 'straight and dusty, lined with ramshackle huts', he was driven north of the city to the Indian Statistical Institute. Calcutta's winter, in contrast with Prague and in consonance with his mood, was 'mild and pleasant'. Amidst the mango grove and ponds that dotted the institute's campus, Nadler would spend the next 15 months working on India's earliest digital computers.[1]

Beginning in the late 1940s, the Bengali statistician Prasanta Chandra Mahalanobis embarked on a campaign to bring computers to India, a country that had none.[2] The Indian Statistical Institute, an institution he founded and directed, also attempted to manufacture them domestically at its Baranagore campus, north of Calcutta. India's first analogue computer was developed here in 1953 and, when a digital computer was finally installed in 1956, it was the

[1] M. Nadler, *No Regrets* (2008), Chapter 26, http://filebox.vt.edu/users/tampsa/pdf.files/26.%20Flight%20from%20Prague.pdf [accessed 30 November 2015].

[2] P. C. Mahalanobis (1893–1972) was the founder and Director of the Indian Statistical Institute. Educated at Presidency College (Calcutta) and Cambridge University, Mahalanobis returned to India and taught physics at his alma mater in Calcutta. Mahalanobis founded the Indian Statistical Institute in 1931 and, in 1933, he began *Sankhyā*, a statistics journal, of which he was the editor. As a statistician, his stature stemmed from making pioneering contributions to the design and application of large-scale sample surveys. He was elected Fellow of the Royal Society in 1945, inducted as Foreign Member of the Union of Soviet Socialist Republics Academy of Sciences in 1958, and elected Fellow of the American Statistical Association in 1961. He was a member of India's Planning Commission between 1955 and 1967.

first digital computer not only in India, but also in Asia (outside Japan). Mahalanobis and the Indian Statistical Institute determinedly pursued computers across the world, negotiating the segmented Cold War atlas, because they believed computers were crucial to the project of economic planning in India.[3] This time-consuming and enormously expensive pursuit was rationalized on the grounds that computers were vital to national development. Centralized planning was premised on the ability to calculate masses of data; computers presented a revolutionary means to do so. Mahalanobis tried to harness computers towards the creation of an idealized economy—one in which numerical omniscience allowed optimal outcomes. In Mahalanobis's vision, the computer's liberation from human computational constraints also promised, when yoked to planning, a liberation from underdevelopment.

This article excavates the role played by a technology (computers) and an institution (the Indian Statistical Institute) in economic planning during the decade and a half following decolonization. Studying the intersection between planning, statistics, and computers in independent India, it highlights the manner in which Mahalanobis and the Indian Statistical Institute braided these strands. Through tracking this unexplored story of international technology transfer during the Cold War—the computer's journey to India—it opens a new window onto the expanding ambit of the Indian Statistical Institute's activities in early post-colonial India and its intimate involvement with economic planning. Apart from underscoring the influence wielded by technocrats such as Mahalanobis during this phase of nation building, the episode also reveals the techno-utopic vision that undergirded the idea of a centrally planned economy, and the extent to which India's economic problems (and its solutions) were thought to be essentially calculable. Finally, it demonstrates how India, consistent with its government's formal non-alignment with either Cold War

[3] Founded in 1931, and registered as a non-profit learned society in 1932, the Indian Statistical Institute emerged out of the Statistical Laboratory that Mahalanobis began in his room at Presidency College in the 1920s, swiftly becoming India's foremost institution for statistical research. The Indian Statistical Institute's activities and funding during its early decades were determined by the projects it worked on contract for the government and private firms. This included research on flood control in Bengal and Orissa, agricultural field trials, sample surveys to estimate crop yields, meteorology, and demography. In the 1950s, it became closely associated with the National Sample Survey and studies on economic planning. It was deemed an 'institution of national importance' with the status of a university in 1959 through the passage of the Indian Statistical Institute Act in parliament.

bloc, sought computers from both sides of the Iron Curtain. India's ability to develop a computer programme did not, however, depend solely on its own foreign policy orientation or domestic needs. As an impoverished buyer on the market for computers in the 1950s, its image in the optics of the Cold War mattered. Despite official non-alignment, American and Soviet perceptions of India's undeclared political slant, and their estimation of the uses to which computers would be put, framed real limitations on computer developments in India.

The inauguration of economic planning in 1950 with the establishment of the Planning Commission raised the prestige of statistics as a discipline in India. Beginning in 1949, and within half a decade, India developed a substantial national statistical infrastructure. During this short span, Mahalanobis became the Statistical Adviser to the government and Chairman of the National Income Committee; a Central Statistical Organization emerged; and one of the largest sample survey exercises in the world—the National Sample Survey—was instituted. The Indian Statistical Institute and its personnel were intimately involved in each of these developments. On 3 November 1954, at a ceremony presided over by Prime Minister Jawaharlal Nehru, the Indian Statistical Institute began a separate unit to study economic planning, formally inducting it into the planning process. In the spring of 1955, the year he became a member of the Planning Commission, Mahalanobis submitted a 'Draft Plan-Frame' to the Government of India: it would become the template for India's Second Five-Year Plan (1956–61).[4] In the span of a few years, Mahalanobis had evolved into a national figure and the Indian Statistical Institute found itself elevated from an academic institute to a nodal agency in the formulation of the country's Five-Year Plans.

[4] Mahalanobis had met Jawaharlal Nehru several times before the Second World War, usually when the young Congress leader called on Rabindranath Tagore. Their conversations on planning began in 1940 at Anand Bhavan, the Nehru family home in Allahabad. Mahalanobis recalls them staying up past two in the morning discussing the future of economic planning in the country. In 1950, Prime Minister Nehru considered making the man he described as the 'presiding genius of statistics in India' a member of the inaugural Planning Commission. Nehru decided against it then, but the statistician did become a de facto Planning Commission member in 1955. P. C. Mahalanobis, *Talks on Planning*, Statistical Publishing Society, Calcutta, 1961, p. 3; S. Gopal (ed.), *Selected Works of Jawaharlal Nehru*, Series II, vol. 17, Jawaharlal Nehru Memorial Fund, New Delhi, 1995, p. 288; Letter from Jawaharlal Nehru to Vallabhai Patel dated 20-2-1950, File No. 37, Part 1, Jawaharlal Nehru Papers, Nehru Memorial Museum and Library, New Delhi (henceforth NMML).

Tasked with generating the statistics that would numerically define the nation and facilitate economic planning, Mahalanobis and the Indian Statistical Institute were uniquely placed to foresee the need for computers. It was no accident that the individual and institution involved in bringing the first computers to the country were those most intimately associated with statistics and planning in independent India. The years during which computers made their entry into India were also those during which Mahalanobis and the Indian Statistical Institute acquired unprecedented national influence, gravitating towards the heart of the planning process. Planning the economy demanded a variety of statistical indicators regarding Indian material life. The magnitude of socio-economic data generated, combined with the need to comprehend it within strict time constraints, meant that it was beyond the country's computational abilities—unless computers were imported. Computers represented a solution to the problem of big data—a problem that arose as a consequence of the decision to pursue centralized economic planning. Unlike in the global centres of computer development, the first use found for computers in India was not military; it was explicitly justified on developmental grounds.

The historical literature on Indian computing is sparse, as is that on the career of computers outside Europe, the United States, and the Soviet Union.[5] Not only has there been no study of the decade-long campaign to bring India its first computers, the relationship between it and economic planning has also been overlooked.[6] Much of the historical scholarship on planning in India has been on the period predating political independence in 1947.[7] Most studies have

[5] A notable book on the history of computers outside the United States, the United Kingdom, and the Soviet Union is Eden Medina, *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile*, MIT Press, Cambridge, 2011.

[6] The few works that do address the history of computers in India swiftly skip past development during the late 1940s and 1950s at the Indian Statistical Institute to a discussion of computer programmes instituted elsewhere in the 1960s. These include, for example, the Tata Institute of Fundamental Research's TIFRAC, which was commissioned in 1960, and IIT Kanpur's computer education centre which began in 1964. See R. K. Shyamsundar and M. A. Pai (eds), *Homi Bhabha and the Computer Revolution*, Oxford University Press, New Delhi, 2011; R. Bassett, 'Aligning India in the Cold War Era: Indian Technical Elites, the Indian Institute of Technology at Kanpur, and Computing in India and the United States', *Technology and Culture*, vol. 50, no. 4, October 2009, pp. 783–810; D. C. Sharma, *The Long Revolution: The Birth and Growth of India's IT Industry*, Harper Collins India, Noida, 2009; V. Rajaraman *History of Computing in India (1955–2010)*, IEEE Computer Society, Bangalore, 2012.

[7] See B. Chakrabarty, 'Jawaharlal Nehru and planning, 1938–41: India at the crossroads', *Modern Asian Studies*, vol. 26, no. 2, 1992, pp. 275–87; R. Chattopadhyay,

focused on the content of planning as an ideology, and the question of its effectiveness in fulfilling economic objectives.[8] This article contributes to the relatively thin, but growing, historical literature on the experience of economic planning in independent India and the varied processes it set in motion.[9] In particular, it sheds light on the Indian Statistical Institute's involvement in planning, its surprisingly overlooked contribution to the genesis of computers in India, and India's distinctive choice to use its earliest computers for developmental rather than military applications. In doing so, it helps us understand the significance the question of calculation assumed in the formulation of India's Five-Year Plans, and the manner in which Cold War politics affected international technology transfer and economic research for planning in India.

Fleeing to India

A Jewish boy from Brooklyn, Morton Nadler had joined the Communist Party of the United States in 1936. During the Second World War,

'An early British government initiative in the genesis of Indian planning', *Economic and Political Weekly*, vol. 22, no. 5, January 1987, pp. 19–29; B. Zachariah, *Developing India: An Intellectual and Social History, c. 1930–50*, Oxford University Press, Oxford, 2005; M. Kudaisya, '"The promise of partnership": Indian business, the state, and the Bombay plan of 1944', *Business History Review*, vol. 88, Special Issue 01, Spring 2014, pp. 97–131.

[8] See P. Chatterjee, 'Development planning and the Indian state', in *The State and Development Planning in India*, T. J. Byres (ed.), Oxford University Press, Oxford, 1994; V. Chibber, *Locked in Place: State-Building and Late Industrialization in India*, Princeton University Press, Princeton, 2006; S. Bose, 'Instruments and idioms of colonial and national development', in *International Development and the Social Sciences*, F. Cooper (ed.), University of California Press, Berkeley, 1998; G. Prakash, *Another Reason: Science and the Imagination of Modern India*, Oxford University Press, Delhi, 2000, Chapter 6. For more general accounts of planning in India independent India, see S. Khilnani, *The Idea of India*, Farrar, Straus and Giroux, New York, 1999, Chapter Two; and R. Guha, *India after Gandhi: The History of the World's Largest Democracy*, Harper Perennial, New Delhi, 2007, Chapter Ten.

[9] See M. Kudaisya, '"Mighty adventure": institutionalising the idea of planning in India', *Modern Asian Studies*, vol. 43, no. 4, July 2009, pp. 939–78; M. Kudaisya, 'Developmental planning in "retreat": ideas, instruments, and contestations of planning in India, 1967–1971', *Modern Asian Studies*, available on CJO 2014 doi:10.1017/S0026749X13000644; D. C. Engerman, 'Learning from the East: Soviet experts and India in the era of competitive coexistence', *Comparative Studies of South Asia, Africa and the Middle East*, vol. 33, no. 2, 2013, pp. 227–38. N. Menon, '"Help the Plan—Help Yourself': Making Indians Plan-Conscious," in G. Prakash, M. Laffan, and N. Menon (eds.) *The Postcolonial Moment in South and Southeast Asia*, Bloomsbury Academic, London (forthcoming 2018).

the combination of Nadler's crimson sympathies and his training as a radio engineer raised eyebrows at the Federal Bureau of Investigation (FBI).[10] In 1946, he was fired from the Belmont Radio Corporation in Chicago because of pressure from the United States Army.[11] Incensed by the dismissal and fuelled by a vision in which he channelled his technical skills towards the 'building of socialism', Nadler decided to seek employment abroad. Informing his parents and passport authorities that he was headed to Paris for a doctorate at the Sorbonne, Nadler departed aboard the SS *America*. On 6 March 1948, a 27-year-old Nadler boarded a flight from Paris to Prague.[12] He would spend the next decade within the Soviet bloc, in communist Czechoslovakia.

Nadler began his life in Eastern Europe working for TESLA, a state-owned electronics and telecommunications enterprise, on radar systems. Within a year and a half of his arrival in the country, and unbeknownst to him, the United States Department of the Army asked J. Edgar Hoover (Director, Federal Bureau of Investigation) to investigate him, believing 'the possibility exists that Nadler may be passing information on radar developments to the Czechoslovakians'.[13] When Nadler went to the American Embassy in Prague to renew his passport, it was confiscated and he was informed it would be returned only if he bought a one-way ticket back to the United States.[14] Unaware of the gravity of the case being built against him by the Federal Bureau of Investigation and Central Intelligence Agency (CIA), and also under scrutiny by a Czechoslovak government that

[10] The account of Nadler's life is based primarily on his unpublished memoirs entitled *No Regrets*, Chapter 17.

[11] Ibid., Chapter 18.

[12] Ibid., Chapter 19.

[13] Ibid., Chapter 21.

[14] There were Americans who spied for the Soviet Union. Two of them—Joel Barr and Alfred Sarant—were associates of Julius and Ethel Rosenberg (executed in 1953 on charges of espionage). Barr and Sarant obtained American military secrets, evaded arrest, and helped build the earliest advanced computer and weapons systems for the Soviet Union. They were both in Prague from 1950 to 1955 and Nadler recalled meeting them in 1955. Introduced to him as Filipp Staros and Joe Berg, they attempted to persuade Nadler to join them in Leningrad. Tempted, but unable to decide immediately, he asked them to stay in touch. Later, Staros wrote to Nadler from the Soviet Union, luring him with descriptions of the facilities at their disposal. When Nadler asked what he would work on, they responded 'an eye in the sky'. While he could not make sense of it then, he would later realize that they were referring to Sputnik. Nadler claims that this was the extent of their interaction. Nadler, *No Regrets*, Chapter 21; S. Usdin, *Engineering Communism: How Two Americans Spied for Stalin and Founded The Soviet Silicon Valley*, Yale University Press, New Haven, 2005, pp. 174, 184.

suspected him of being an American spy, Nadler renounced American citizenship and embraced that of his adopted home.[15] In 1955, he began working at Czechoslovakia's premier computer institute—the Institute of Mathematical Machines.

While his disenchantment with the communist system in Czechoslovakia had been growing for years, news of Soviet tanks rolling into Budapest in the autumn of 1956 to crush the Hungarian Revolution left Nadler thoroughly disillusioned. Looking for ways to leave the country, he found that, not only was the Czechoslovak government reluctant to grant him passage, but the American Embassy would also not furnish him a visa.[16] Czechoslovak authorities believed he possessed information too sensitive to depart with, and Hoover suspected it was a sinister ploy to 'assist Czechs or Soviets for intelligence purposes'.[17] Hoover's network of informants included Nadler's own mother, who had approached the Federal Bureau of Investigation in Chicago seeking 'the Director' and offering to relay information about her wayward communist son.[18] In short, Nadler's life had begun to approximate a 'parody of a John Le Carré spy'.[19] He was forced to choose between leaving the country illegally or, as some friends suggested, get 'invited to some country that the communist government of Czechoslovakia couldn't refuse, such as India'.[20] India was an opportune destination because it was officially non-aligned in the Cold War and was being courted by the Soviet Union. As a cable from the American Embassy in Prague observed:

> ... the local [Czech] authorities would be able, on the one hand, to rid themselves of a dissatisfied convert and, on the other hand, to avoid the

[15] Nadler's renunciation of American citizenship was reported in the *New York Times*. 'Citizenship renounced: American in Prague says he seeks Czech nationality', *New York Times*, 4 November 1950, p. 34. Nadler, *No Regrets*, Chapter 21.

[16] The Walter-McCarran Act deemed ineligible for an entry visa 'anybody who is or has ever been' a member of a long list of subversive groups. Nadler had been a member of at least eight. Nadler, *No Regrets*, Chapter 24.

[17] Ibid., Chapter 25.

[18] Dorothy Luria Nadler went to the Federal Bureau of Investigation on 9 January 1958. In her interview with Special Agents, she said 'she and her husband abhor communism and accordingly they have denounced their son'. She asked for advice on how to respond to her son's letters and announced 'she would be willing to furnish all information in her possession concerning her son, his past activity and the activity of his wife'. Morton Nadler would learn about his mother's contact with the Federal Bureau of Investigation years later when sifting through documents in his Freedom of Information file. Ibid.

[19] Ibid., Chapter 24.

[20] Ibid., Chapter 24.

publicity which would appear in the world press as a result of his turning from the unfilled promises of Communism directly to the bounties of capitalism.[21]

As for Nadler, whose secret ambition was to return to the United States, spending time in India would serve as a necessary 'cooling-off period', diluting the stain of communism in the eyes of America, and pacifying its authorities that he was not a spy.[22]

Around this time, Nadler encountered an Indian student who was searching for an English-speaking scientist to help with his post-graduate practical training. Nadler became a mentor to him, overcoming his confusion over 'the way Indians rock their head from side to side ... instead of nodding up and down'. Through this student, Nadler made contact with the Indian Statistical Institute in Calcutta. Repeated visits to the Indian embassy, and a friendship with the Third Secretary there, yielded information about a visit to Prague by P. C. Mahalanobis—the decorated statistician, and de facto author of the Second Five-Year Plan then underway in India.

Tall, thin, prominently nosed, stern of gaze, vast of brow, and with hair uncompromisingly parted and slicked flat, Mahalanobis bore the mien of a serious man. As a friend of nearly half a century put it, he had 'no small talk and little capacity to compromise with unreason'.[23] An urbane savant, the Professor (as he was known in academic and government circles, and as he occasionally signed correspondence) was 'a physicist by training, statistician by instinct and planner by conviction'.[24] But also much more: he was versed in ancient Sanskrit texts, possessed a discerning ear for Bengali poetry (as an authority on the work of his friend, the Nobel laureate Rabindranath Tagore), dabbled in architecture, and pursued interests ranging from anthropometry to flood management. A polymath—although of uneven talents.[25]

[21] Ibid., Chapter 25.
[22] Ibid.
[23] P. C. Mahalanobis, *Papers on Planning*, Statistical Publishing Society, Calcutta, 1985, p. xlv.
[24] C. R. Rao, 'Prasantha Chandra Mahalanobis 1893–1972', *Biographical Memoirs of Fellows of the Royal Society*, vol. 19, December 1973, p. 455.
[25] For further details on P. C. Mahalanobis's life, see ibid.; A. Rudra, *Prasanta Chandra Mahalanobis: A Biography*, Oxford University Press, Delhi, 1996); A. Mahalanobis, *Prasanta Chandra Mahalanobis*, National Book Trust, Delhi, 1983; and H. Sanyal, 'Prasantachandra Mahalanobis: a biographical sketch', *Sankhyā: Indian Journal of Statistics*, vol. 35, Supplement: Prasanta Chandra Mahalanobis, December 1973, pp. 3–11.

When Mahalanobis arrived in Prague, Nadler met him along with the resident Indian Ambassador, J. N. Khosla. The Professor invited Nadler to join the Indian Statistical Institute's staff for two years and the Ambassador helped clear bureaucratic hurdles. Nadler would proceed to honour his contract with the Indian Statistical Institute—'to work on electronic computers and to train graduate students in computer hardware R&D'.[26]

Unfortunately, Nadler's archival trail runs cold with his departure to India.[27] However, to grasp how a young communist from Brooklyn who had renounced both American and Czech citizenships, inviting the unwelcome interest of intelligence agencies on both sides of the Iron Curtain, wound up on a verdant campus outside Calcutta, we must consider what brought him there: India's nascent computer programme. And the tale of computers in India cannot be narrated without economic planning playing the lead.[28]

[26] Nadler, *No Regrets*, Chapter 25; and Record No. 74, Prasanta Chandra Mahalanobis Memorial Museum and Archives, Kolkata (henceforth PCMMMA).

[27] Nadler's memoir ends with his arrival in Calcutta. We know he spent the year 1959 at the Indian Statistical Institute as Electronic Data Processing Machine consultant, working primarily at the institute's Computer Laboratory that was managed by S. K. Mitra. His book, *Topics in Engineering Logic* (1962), was based on lectures he delivered at the Indian Statistical Institute in the spring of 1959. He also published an article, 'Some notes on computer research in eastern Europe', while in Calcutta. In 1960, he joined *Cie des Machines Bull* in Paris as a Research Adviser, where he worked until 1972. He then worked at as scientific adviser to Inria, a French public computational sciences research organization, until 1983. Nadler would become a pioneer in pattern recognition, especially optical character recognition (OCR), founding North American Digital Logic Inc. in 1985 (a company that, post renaming and acquisition, would deliver the Central Intelligence Agency a multilingual OCR system). He eventually became a professor of electrical engineering at Virginia Tech in 1984, serving on its faculty until 1991. Nadler was computer savvy until the end of his days: at the time of his death on 13 November 2013, at the age of 92, he possessed an active Facebook profile. "Morton Nadler" in *IEEE Transactions on Electronic Computers*, 1963, p. 927, http://ieeexplore.ieee.org/stamp/stamp.jsp?reload=true&arnumber=4038046 [accessed 27 March 2017]; M. Nadler, *Topics in Engineering Logic*, Pergamon Press, New York, 1962; M. Nadler, 'Some notes on computer research in eastern Europe', *Communications of the ACM*, vol. 2, no. 12, December 1959, pp. 1–2; 'In memoriam: Morton Nadler, Professor', News/Events: Bradley Department of Electrical Engineering, Virginia Tech, https://www.ece.vt.edu/news/article/in-memoriam-morton-nadler-professor [accessed 27 March 2017].

[28] Mahalanobis was not alone in his faith in computers' ability to transform economic management. At least two very prominent mid-twentieth-century economists, Tjalling Koopmans and Oskar Lange, argued that computers provided a solution to the computational complexities of centralized economic planning. This contention was part of a debate among economists, the 'economic calculation' or

Machine dreams

From when he first laid eyes on an electronic computer—the Mark II at Harvard in 1947—Mahalanobis was smitten.[29] Amazed by its abilities and convinced of its utility to his country's development, he was soon involved in a quest to bring these machines to India—an affair that would last for much of the rest of his life.

In early 1946, at joint meetings of the American Philosophical Society and the American Academy of Sciences in Philadelphia and Washington, he had heard the mathematician–physicist John von Neumann present an account of a computer under development at the Institute of Advanced Study in Princeton.[30] Mahalanobis discussed the possibility of developing a computer in India with von Neumann, who was open to the idea. In fact, von Neumann said he would be willing to

'socialist calculation' debate, that had begun in the late nineteenth century, but gained momentum during the First World War with the successes reported in state-directed production planning. In the inter-war years, defenders of the unfettered market such as Ludwig von Mises, Friedrich Hayek, and Lionel Robbins published influential articles arguing that planned economies were fundamentally incompatible with the efficient allocation of resources because they abandoned the only instrument that guaranteed it—the 'invisible hand'. The Polish socialist Oskar Lange responded that 'rational economic accounting' was certainly possible under socialism—planners only needed to solve a system of simultaneous equations. Hayek retorted that, since solving thousands of such calculations in any reasonable timeframe was impossible, efficient planning remained a chimera. The invention of the computer changed this. At a conference in 1949, Koopmans declared 'To von Mises' arguments regarding the unmanageability of the computation problems of centralized allocation, the authors oppose the new possibilities opened up by modern electronic computing equipment'. Lange, who knew Mahalanobis well and visited the Indian Statistical Institute several times in the 1950s, published a short essay in 1967 claiming that socialist planning had been vindicated: 'Were I to rewrite my essay today my task would be much simpler. My answer to Hayek and Robbins would be: so what's the trouble? Let us put the simultaneous equations on an electronic computer and we shall obtain the solution in less than a second.' Mahalanobis, it appears, was a silent partisan. F. A. Hayek (ed.), *Collectivist Economic Planning*, Routledge and Kegan Paul, London, 1963); P. Erikson, J. L. Klein, L. Daston, R. Lemov, T. Sturm, and M. D. Gordin, *How Reason Almost Lost Its Mind*, University of Chicago Press, Chicago, 2013, pp. 70–1; T. Kowalik (ed.), *Economic Theory and Market Socialism: Selected Essays of Oskar Lange*, Edward Elgar Publishing Co., Brookfield, 1994, pp. 252–300, 361–5.

[29] Letter from P. C. Mahalanobis (henceforth PCM) to Maurice F. Ronanyne, dated 12 February 1960, Record No. 74, PCMMMA.

[30] Mahalanobis was attending this event as a representative of the National Institute of Sciences of India. Another Indian representative was Homi J. Bhabha, who had only recently founded the Tata Institute of Fundamental Research (TIFR) in Bombay. Bhabha would soon spearhead India's nuclear programme as first Chairman of the Atomic Energy Commission.

work on an Indian computer the following winter but warned that the cost of building it would be steep. The next month, while in New York, Mahalanobis met with statistics faculty from Columbia University and visited the Watson Computation Laboratory. Based on these conversations, he concluded that if statistics were to progress in India, it was 'essential to build up at least one first rate computation and calculating laboratory': it was a matter deserving 'serious attention at an early date'.[31]

Within a year, Mahalanobis was in touch with John Mauchly, of the Eckert–Mauchly Corporation, regarding the purchase of an electronic computer.[32] In a memorandum to his staff, Mauchly listed Mahalanobis as a potential customer for the UNIVAC (Universal Automatic Computer)—the world's first commercially produced electronic digital computer. The letter described him as 'anxious to contract for UNIVAC as soon as we were in a position to make definite terms'.[33] Perhaps the UNIVAC's advertisement brochure had caught Mahalanobis's eye. It boasted that this computer could solve problems that are now 'considered impossible because of prohibitive costs associated with conventional methods of solution'. Listed among the 'impossible' knots the UNIVAC could untie was 'economic planning'.[34]

Increasingly occupied with national income assessment, national sample surveys, and planning in India, Mahalanobis believed that computers were vital to addressing them. Digital computers could perform complex mathematical calculations at hundreds of times the speed of humans. The Professor saw that they would be of tremendous

[31] Mahalanobis continued to make enquiries about calculating machines throughout his stay in America and during the few days he spent in London before returning to India. He talked to R. C. Allen & Co. in Michigan and British Tabulating Machine & Co. in London regarding possible purchases. Ibid., pp. 405, 409, 410.

[32] John Mauchly and Presper Eckert built the first general-purpose electronic digital computer (ENIAC) at the University of Pennsylvania in 1943. They founded their own company, Eckert–Mauchly Corporation, which was acquired by Remington Rand in 1950.

[33] The UNIVAC was delivered to the United States Bureau of Census in 1951. Mauchly to staff, dated January 1948, as quoted in P. Ceruzzi, *History of Modern Computing*, MIT Press, Cambridge, 2003, pp. 26–7.

[34] To be sure, it is unlikely that the advertisement meant centralized economic planning on the national scale when it referred to 'economic planning'. While this may not have been an advertisement directed toward socialist economies, it definitely was aimed at government agencies and large corporations that dealt with complex economic calculations and forecasts. Brochure for 'The UNIVAC System' (1948), Computer History Museum, http://archive.computerhistory.org/resources/access/text/2010/08/102646308-05-01-acc.pdf [accessed 27 March 2017].

help in tabulating and processing the data emanating from the National Sample Survey—a massive socio-economic survey established in 1950 to continually track different aspects of the economy such as consumption, employment and unemployment, land and livestock holdings, and crop output.[35] By feeding this raw information into a computer, economic planners would be able to generate estimates and parse trends about the Indian economy in a fraction of the time it would otherwise take. The other major application for computers in the realm of planning was in mathematically modelling the economy, specifically through the creation of inter-industry input–output tables. These tables, first systematized by the Russian–American economist Wassily Leontief, defined the interrelationship between different sectors of the economy based on the understanding that one industry's output is often the input for another.[36] The input–output table became a widely adopted method for tracking the movement of goods and services between sectors of the economy, providing a structural snapshot of the entire economy.[37] Unburdened by any formal training in economics, Mahalanobis was instinctively predisposed toward this method of mathematically abstracting the economy. Quite apart from these practical applications, the computer was also an object of desire, prestige, and fantasy, chased as much for the fabulous possibilities it evoked as for the more modest capabilities it delivered. It was rare, notoriously expensive, and seemingly boundless in potential: promising the future and appearing to belong to it.

In the decade and a half after independence, the Professor sought ways by which to manufacture computers in India (a technical challenge) or import them (at huge expense). While the dream of a computer in India would have to wait a few more years to come to fruition, the Indian Statistical Institute did open an Electronics Laboratory and Workshop on an experimental basis in 1950 whose

[35] Until 1970, the Indian Statistical Institute was in charge of all aspects of the National Sample Survey (NSS), except conducting the fieldwork. That was done by a government agency—the Directorate of the National Sample Survey.

[36] Wassily Leontief would win the Nobel Prize in Economics in 1973, primarily for his work on input–output matrices.

[37] From this point on, the United States continued to conduct input–output research on a regular basis, except for a few years in the 1950s when the Eisenhower Administration shut it down due to its perceived proximity to planning in communist countries. K. R. Polenske, 'Leontief's "magnificent machine" and other contributions to applied economics', in *Wassily Leontief and Input–Output Economics*, E. Dietzenbacher and M. L. Lahr (eds), Cambridge University Press, Cambridge, 2004, p. 12.

brief was to deliver an electronic computer.[38] In charge of this project was the mathematician and engineer Samarendra Kumar Mitra, one of the few Indians with any training in computers. The previous year, Mitra had been offered a United Nations Educational, Scientific and Cultural Organization (UNESCO) Fellowship to travel abroad to study electronic computers. Initially hesitant, he was encouraged by Mahalanobis and physicist S. N. Bose to accept. Upon completion in 1950, Mitra joined the Indian Statistical Institute.[39] The only other employee who worked in what came to be called the Electronic Division was a young technician, Soumyendra Mohon Bose.[40] By 1953, Mitra and the Electronics Division had delivered India's first analogue computer: a small machine capable of solving simultaneous linear equations of up to ten variables.[41] Lacking the resources to import expensive parts, it was built using materials salvaged from Second World War surplus in the scrap heaps and disposal depots of Calcutta's Chandni Chowk market.[42] To the Professor, it was a matter of pride that 'we have built it ourselves'.[43] In December, the prime minister visited to see the country's first computer in operation. Early the following year, work began on a grander project—building a large-capacity digital computer at the Indian Statistical Institute.

In the first half of the 1950s, Mahalanobis was involved in several informal discussions in Washington regarding America's ability to offer India technical aid through the Technical Cooperation Administration (TCA) or under the Point Four initiative.[44] The Professor was after money, equipment, and the technicians necessary to build computers in Calcutta.[45] After more than three years, like

[38] The workshop also manufactured, maintained, and repaired desk calculators, punched card machines, precision measuring instruments, and machine tools. Indian Statistical Institute, 'Twenty-second Annual Report: 1953–54', *Sankhyā: The Indian Journal of Statistics (1933–1960)*, vol. 14, no. 4, February 1955, p. 395.

[39] S. S. Mitra, 'A child grown into manhood', *Samvadadhvam*, vol. 1, no. 3, March 1957, pp. 10–11.

[40] Record No. 74, PCMMMA.

[41] Though the computer was not christened, it is referred to in one Indian Statistical Institute annual report as the Analogue Linear Equation Solving Machine. Record No. 74, PCMMMA; and D. Sinha, 'Glimpsing through early days of computers in Kolkata', p. 5, http://goo.gl/8lTLwo [accessed 15 November 2015].

[42] Sharma, *The Long Revolution*, p. 7.

[43] Speech by Mahalanobis quoted in Indian Statistical Institute, 'Twenty-second Annual Report", p. 406.

[44] Announced by President Harry S. Truman in 1949, the Point Four programme provided technical assistance to developing countries.

[45] Note made by PCM on 9/6/57, Record No. 72, PCMMMA.

his experience with the Eckert–Mauchly Corporation, he was left with nothing to show for it. He wondered whether these efforts failed due to officials in New Delhi not understanding the real value of technical aid to the Indian Statistical Institute. In a letter to his colleague, Pitambar Pant, he conveyed his frustration: 'It is so hard to explain that this is not an isolation (*sic*) item but is closely integrated with a general plan of development of statistics—which, in turn, is an essential step in national planning.'[46]

During the spring and summer of 1954, he travelled with his wife, Nirmal Kumari Mahalanobis, and S. K. Mitra through Europe, the United States, and the Union of Soviet Socialist Republics (henceforth 'the Soviet Union'), meeting economists and statisticians, visiting institutes, attending sessions of the UN Statistical Commission (at which he was elected Chairman—backed by representatives from both the United States and the Soviet Union), tracking down computer equipment, and sniffing out avenues through which to bring a digital computer to India.[47] Importing a computer, or building one at home, was an urgent matter. As the Professor put it to Mitra:

> ... we must proceed with electronic computers with all possible speed. Otherwise we will never be able to cope with the tremendous volume of primary information which is accumulating through the NSS [National Sample Survey] every month. Secondly, for planning ... the help of high speed electronic computers would be simply indispensable. Under [the] most favourable circumstances it would take 18 months or 2 years to do anything tangible and I am desperately anxious to start work.[48]

[46] Pitambar Pant was a friend of both Jawaharlal Nehru and P. C. Mahalanobis. Imprisoned during the Quit India movement in 1942, he had met Jawaharlal Nehru in jail and served as his secretary there. During this time, he developed an interest in economic planning that would last the rest of his life. After independence, Nehru sent Pant to the Indian Statistical Institute to help Mahalanobis. Pant would lead an Indian Statistical Institute cell in Delhi and enter the Planning Commission staff in 1956 as head of the Manpower Division and in 1958 led the Perspective Planning Division. He was, however, present at Planning Commission meetings from even earlier in his capacity as secretary to the Chairman of the Planning Commission (the prime minister). Pant rose to the rank of Planning Commission member in 1967. He would also serve as honorary Joint Secretary of the Indian Statistical Institute. Letter from PCM to Pant, sent from London, 23 June 1954, Pitambar Pant Papers, NMML.

[47] The Professor wanted another Indian Statistical Institute employee who worked in the Electronics Division, Mani Mukherjee, to join him in the search, but it was too expensive for the Indian Statistical Institute to afford. Letter from PCM to Pant, sent from Geneva, 12 April 1954, Pitambar Pant Papers, NMML.

[48] Letter from PCM to Pant, sent from London, 23 June 1954, Pitambar Pant Papers, NMML.

Whilst in London, Mahalanobis and Mitra took a keen interest in a computer being sold by the British Tabulating Machine Company (BTM). Unlike other computers they had seen or heard of, this appeared to match their need and means. The Hollerith Electronic Computer Model 2M (HEC 2M) was noted for its flexibility in the kinds of operations it could perform. And, though its computing capabilities were modest, the Professor felt that it would prove adequate. While he was really after computers that could do much more, they came with additional digits on the price tag and he realized that purchasing one immediately would help in gaining valuable experience in working with digital computers.[49] After all, apart from Mitra, nobody at the institute had any experience with them. Having inspected the machine, Mahalanobis was told that it would cost £18,500 and that it would be ready by April 1955. It would take nine months to manufacture, three to ship to India, and two more to set up in Calcutta. British Tabulating Machine Company had made it clear that they would not assume responsibility for its installation or maintenance in India. This meant that the Indian Statistical Institute would have to depute a couple of workers to spend a few months at the British Tabulating Machine Company workshop to observe its assembly, and to be trained in running it.

During his stay in America, Mahalanobis was based in New York and made short visits for talks and conferences to North Carolina, Washington DC, Berkeley, and Palo Alto. Computer technology in the United States had made great strides, but the Indians were constrained by their cost; the computers were far more expensive than those in Europe. The UNIVAC used by the United States Bureau of Census, for example, cost over a million dollars and a further $200,000 annually for upkeep.[50] Purchasing an electronic computer in America, Mitra and the Professor agreed, was simply unaffordable. Cost was a significant consideration, narrowing their options; India was still a poor republic and foreign exchange was a scarce resource that it could not be profligate with. But India could not wait indefinitely for a computer either. As he wrote in a letter to Pitambar Pant from London later that year:

I have a great sense of urgency. I know that the NSS would get choked without electronic equipment. I know that real planning would require the use of such

[49] Ibid.
[50] At the time, $200,000 was roughly equivalent to one million Indian rupees.

computers—of course, NSS also is for real planning—but I meant the work of economic analysis at a higher level and the solving of numerical equations or preparing numerical tables and projections.[51]

The Professor's itinerary had them pass through the Soviet bloc as well. Writing from Prague, he told Pant that his purpose in visiting the Soviet Union on this, his third, visit was to 'explore what help we can get in economic planning or in constructing electronic computers'.[52] He had laid the groundwork for Moscow months in advance. In February 1954, he had attended an informal lunch hosted by Prime Minister Nehru in New Delhi for the Soviet delegation of scientists to the Indian Science Congress. Mahalanobis found himself opportunely seated next to the Soviet Ambassador Mikhail Menshikov—who would later become Ambassador to the United States, where his reputation as 'fashionably attired, faultlessly mannered' earned the moniker 'Smiling Mike'.[53] The Professor casually asked Menshikov whether the Soviet Union would be able to help India in developing digital computers. The secrecy surrounding Soviet computer research was such that it was not even known to Mahalanobis 'whether U.S.S.R. had started making such computers'.[54] Cold War security fears and inter-agency competition in Moscow had plunged their computer programme into a virtual information blackout both within and outside the Soviet Union.[55] Strict controls had been placed on covering Soviet

[51] Letter from PCM to Pant, sent from London, 23 June 1954, Pitambar Pant Papers, NMML.

[52] Letter from PCM to Pant, sent from Prague, 27 June 1954, Pitambar Pant Papers, NMML.

[53] Note prepared by PCM and 'handed over to the Prime Minister for his information', dated 4 March 1959, Record No. 119, PCMMMA; *Life Magazine*, 31 March 1958 Issue, p. 46.

[54] Note prepared by PCM and 'handed over to the Prime Minister for his information', dated 4 March 1959, Record No. 119, PCMMMA.

[55] Slava Gerovitch has speculated that the layers of secrecy that Soviet digital computers were enveloped in might have also been a result of a rivalry between the Ministry of Machine Building and Instrument Construction (whose Special Bureau No. 245 was in charge of STRELA) and Soviet Academy of Sciences (which oversaw the Institute of Precision Mechanics and Computer Engineering's development of the BESM). The first agency to develop a large high-speed digital computer was to be rewarded with an order for serial production. The cloak of secrecy began to slip after the death of Stalin in 1953. It was formally acknowledged only in October 1955, when the Soviet Union announced to the world that it had developed high-speed digital computers. For a discussion of the competing Cold War pressures of suppressing information about computer developments and publicizing it, see S. Gerovitch, '"Mathematical machines" of the Cold War: Soviet computing, American

computer technology in the Russian press.[56] Mahalanobis's query was hence based only on speculation and a hunch. Not above bluntly reminding the diplomat of the Cold War stakes, he provocatively added 'Surely the U.S.S.R. can have no objection in giving and teaching us things which are known to the Americans'.[57] Taking the bait, Menshikov responded with a laugh—'Why don't you ask us?' The Professor complied and, in the ensuing discussion, the Ambassador suggested drafting a formal letter addressed to the president of the Soviet Union Academy of Sciences and handing it over to the Soviet delegation that was scheduled to fly back to Moscow the following morning. Jumping at the opportunity that had presented itself unannounced, Mahalanobis swung into action. He made an appointment with the prime minister and met him that night with a draft composed. Nehru made some changes to the letter and the Professor took it to the airport the following morning to hand it to the departing scientists. A couple of months later, in April, while in Switzerland to attend the meeting of the UN Statistical Commission in Geneva, he was spotted by the Soviet First Secretary of the Embassy at Berne and handed an invitation. The Soviet Union of Academy Sciences had invited the Professor, along with a delegaryion of Indian scientists, 'as soon as possible to discuss the question of technical aid and equipment for computers'.[58]

Later that summer, the Professor, Mitra, and a delegation of scientists from India spent five weeks in the Soviet Union.[59] On the afternoon of 7 July 1954, the visitors from India were offered a tour

cybernetics and ideological disputes in the early 1950s', *Social Studies of Science*, vol. 31, no. 2, Science in the Cold War, April 2001, pp. 272–6.

[56] Ibid., p. 274.

[57] Note prepared by PCM and 'handed over to the Prime Minister for his information', dated 4 March 1959, Record No. 119, PCMMMA.

[58] This did not go down well with the Indian Ambassador in Berne, Y. D. Gundevia, who expressed his displeasure over the letter passed on to Mahalanobis instead of being formally handed to a diplomat. It is possible that Gundevia was upset because he was kept in the dark regarding the contents of the Soviet letter to Mahalanobis. He carped about this in a letter to N. R. Pillai, the Secretary-General at the External Affairs Ministry. This was not the first time the Professor had trodden on diplomatic toes. Gundevia complained about how Mahalanobis had, on more than one occasion, conducted negotiations with the Soviets—meddling with something that was best left to diplomats. Note prepared by PCM and 'handed over to the Prime Minister for his information', dated 4 March 1959, Record No. 119, PCMMMA; and I. Singh, *Between Two Fires: Towards an Understanding Jawaharlal Nehru's Foreign Policy, Volume 2*, Orient Blackman, New Delhi, 1998, pp. 264–5.

[59] Indian Statistical Institute, 'Twenty-third Annual Report: April 1954–March 1955', *Sankhyā: The Indian Journal of Statistics (1933–1960)*, vol. 16, no. 1/2, December 1955, pp. 18–19.

of the Institute of Precision Mechanics and Computer Engineering in Moscow, where the BESM was being assembled.[60] Apart from working on a project that was of increasing importance to the Soviet regime, the institute also drew strength from the personal backing of Nikita Khurshchev, the recently appointed head of the Moscow city Party organization. Despite the political wind at its back, the personnel at the institute were anxious because the computer they were developing, the BESM, was in a race to completion with another government-sponsored computer programme—the STRELA (under construction by the Ministry of Machine Building and Instrument Construction). The winning machine was to receive an order for serial production from the Soviet government. With the relative thaw in state secrecy following Stalin's death in 1953, the Academy of Sciences attempted to provide the BESM with more visibility to bolster its claim. It was in this context of competitive inter-agency manoeuvring that they declassified BESM's existence in July 1954—coinciding with the visit of the Indian delegation.

Mahalanobis and Mitra were arguably the first scientists outside the institute to be allowed access to the basic schematics of the BESM.[61] They gathered that the Soviet computer programme was fairly advanced. Mitra noted that the institute's facility shared similar dimensions to the one maintained by Bureau of Standards in Washington DC. The *Hindustan Standard* quoted the Professor saying that the institute was as 'well staffed and equipped as any in the United States'.[62] They were also informed of the several universities where computers were being built. Based on his observations, Mitra pronounced Soviet computers more sophisticated that anything he had seen in the United Kingdom—though not quite as cutting-edge as the recent work by John von Neumann at Princeton. However, they could not be certain—alert as they were to the probability that some aspects of Soviet computer infrastructure 'possibly connected with defence' had been kept from view, 'just as Samar could not see or get technical

[60] BESM stood for *Bystrodeystvuyushchaya Elektronnaya Schetnaya Mashina* or 'High-Speed Electronic Calculating Machine'.

[61] The parameters of the BESM would be formally disclosed to other nations more than a year later at the Conference on Electronic Digital Computers and Electronic Processing in Darmstadt, West Germany, in October 1955. Gerovitch, 'Mathematical machines', pp. 274–5.

[62] 'Soviet experts to visit India', *Hindustan Standard*, 19 July 1954, as reproduced in Desp. No. 536, Confidential U.S. State Department Files, India 1950–54, Internal Affairs, RG 59, General Records of the Department of State.

details about some of the machines in USA'.[63] Their tour through Soviet computer facilities may have been carefully choreographed and their view screened. But the suspicion of being blinkered did not irk Mahalanobis: he was not interested in computers for their military applications. Unlike in the United States, England, or the Soviet Union, the Indian quest for computers was not militarily motivated—despite its proven utility and wide use in the field of defence from the Second World War.[64] In the case of India, computers were not sought in order to be weaponized; as Mahalanobis wrote to Pant: 'Such developments are not of any interest to us especially those connected with guided missiles, or defence generally.'[65]

During his stay in the Soviet Union, the Professor also broached the subject of technical aid to help build electronic computers with the Soviet government. He had pursued it with Washington for years with no success and an earlier plea to the Soviets for 'capital goods and technical "know-how"' made at the International Economic Conference in Moscow in April 1952 had also failed. His attempts to 'focus attention on this point' went nowhere, he claimed, because the Soviet Union representatives were 'continually bypassing' it.[66] This time, two years later, his plea was received more sympathetically. He noticed that the discussions he had with Soviet scientists and planners

[63] Letter from PCM to Pant, sent from Moscow, 7 July 1954, Pitambar Pant Papers, NMML.

[64] In the mid-twentieth century, most of the countries that possessed computers used them, at least initially, in military applications. In England, the Colossus was used in code breaking during the Second World War. In America, the US Army Ordnance Department sponsored the development of ENIAC, the first general-purpose electronic digital computer, to facilitate the calculation of artillery firing tables. The first digital computer in Soviet Union, or in continental Europe, the MESM, was used for calculations of rocketry and atomic bombs. As Slava Gerovitch, historian of Soviet computing, put it: 'The primary task of the first computers in a socialist country turned out to be exactly the same as in the capitalist world—calculations for the military.' Gerovitch, 'Mathematical machines', p. 264. For an examination of Soviet endeavour to use a network of computers for economic planning, particularly from the 1960s onward, see S. Gerovitch, 'InterNyet: why the Soviet Union did not build a nationwide computer network', *History and Technology*, vol. 24, no. 4, December 2008, pp. 335–50; and M. Cave, *Computers and Economic Planning: The Soviet Experience*, Cambridge University Press, Cambridge, United Kingdom, 1980. For more on the Chilean attempt to marry computer technology and socialist economic management in the 1970s under Salvador Allende, see Medina, *Cybernetic Revolutionaries*.

[65] Letter from PCM to Pant, sent from Moscow, 7 July 1954, Pitambar Pant Papers, NMML.

[66] Letter from PCM to Pant, sent from Moscow, 27 June 1954, Pitambar Pant Papers, NMML.

were 'much more in quantity and quality than my previous two visits'. The timing of the visit by the Indian scientific delegation had been propitious. Conditions were 'generally favourable', he observed, because there was 'clearly a great deal of appreciation of what JN [Jawaharlal Nehru] has done at the international level and evidently also the desire to have closer and actively cooperative relations with India at the technical level'.[67] 'The whole atmosphere is something wonderful,' the Professor gushed.[68] In fact, he was even quite sure that 'Samar has been given much more technical information about electronic computers in USSR than supplied to the Czechs so far'.[69] He was buoyed further because his 'personal discussions succeeded in securing a large quantity of equipment from USSR'.[70] While this was initially supposed to be channelled through bilateral aid, arrangements were made at the Professor's behest to route it via the United Nations Technical Assistance Administration (UNTAA), since the money pledged to it by the Soviet Union currently lay unused. Because it was to be used for the purposes of national development, rather than just independent scientific research, Mahalanobis also recommended that the equipment should formally become the property of the Government of India, rather than the Indian Statistical Institute.[71]

Later that year in October, having returned to Calcutta, he was relieved to hear that the Indian Ministry of Finance had forwarded the application for technical aid and equipment from the Soviet Union to the United Nations Technical Assistance Administration. He tracked the progress of the application closely because, if accepted, 'a long cherished idea would be on the way to realization, namely, the building of high speed electronic computers and other calculating machines in India'. Reiterating the stakes involved in securing these machines, he described statistical work to Pant as being 'as essential and as important in relation to planning as vitamin is in relation to health'. The aid from the Soviet Union, though a start, would not suffice.

[67] Letter from PCM to Pant, sent from Moscow, 7 July 1954, Pitambar Pant Papers, NMML.

[68] Letter from PCM to Pant, sent from Moscow, 17 July 1954, Pitambar Pant Papers, NMML.

[69] Letter from PCM to Pant, sent from Moscow, 7 July 1954, Pitambar Pant Papers, NMML.

[70] Note prepared by PCM and 'handed over to the Prime Minister for his information', dated 4 March 1959, Record No. 119, PCMMMA.

[71] Note prepared by PCM, dated 4 March 1959, Record No. 119, PCMMMA.

The Professor's ambition was more expansive. His experience chasing computers all over the world, persuading and cajoling foreign officials and private corporations, had convinced him that India could not continue looking abroad for computers, hat in hand. 'I shall not be happy,' he declared, 'until we become independent of other countries in the matter of calculating machines.'[72]

Calcutta's computers

In December 1954, two engineers, Mohimohan Mukherjee and Amaresh Roy, made their way from the Indian Statistical Institute to the British Tabulating Machine Company's workshop in Letchworth, Hertfordshire, where the electronic computer bound for India was being built. It had been purchased by the Government of India and was to be installed at the Indian Statistical Institute on loan. They were in Letchworth to observe the manufacture of the computer, familiarize themselves with its processes, and learn how to operate it. The machine took six months to build—January to June. Their training complete, Roy and Mukherjee travelled through Europe visiting 'computing machine laboratories', returning to India early in 1956.[73] India's first digital computer followed them to the Indian Statistical Institute in two crates.

Ten feet in length, seven in breadth, and six in height, the computer consisted of three vertical metallic cabinets and was housed in an air-conditioned room in the ground floor of an Indian Statistical Institute building at 203, Barrackpore Trunk Road.[74] It took two months to install and, having arrived with no manuals, Roy and Mukherjee had to assemble it based on their notes or instinct. When, for example, the chain-smoking Amaresh Roy realized that he needed a specific clearance (1.8 to 2 millimetres) between the 16 tracks comprising the computer's memory, he found that his trusted cigarette paper did the job just fine. It was also a 'whimsical' machine that could be thrown easily; Mukherjee described how even a speck of dust in

[72] Letter from PCM to Pant dated 2 October 1954, Record No. 90, PCMMMA.

[73] Indian Statistical Institute, 'Twenty-fourth Annual Report: April 1955–March 1956', *Sankhyā: The Indian Journal of Statistics (1933–1960)*, vol. 17, no. 3, December 1956, p. 265.

[74] M. Bhonsle, 'Computer technology in India', Vigyan Prasar Radio Serials, http://www.vigyanprasar.gov.in/Radioserials/Computer%20Technology%20in%20India.pdf [accessed 27 March 2017]; and ibid., p. 265.

an unwelcome place could produce the effect of 'Garbage Out with Data In'.[75] The computer was not easy to use, and Roy and Mukherjee arranged 'learning sessions' to train other engineers at the institute and soon they had formulated informal manuals to instruct others. Within months of it being inaugurated, in March 1956, a dozen workers at the Indian Statistical Institute's Electronics Computer Laboratory had learnt how to work it.

In the preceding two years, the numbers of engineers working at the laboratory had grown. Dwijesh Dutta Majumdar, for example, had joined in September 1955 right after taking the exam for his master's degree. An article in a Calcutta newspaper about Mahalanobis showing the analogue computer to Prime Minister Nehru had caught his eye and drawn him to the institute. When Majumdar met the Professor, he was invited to join the fledgling electronics laboratory—but not before receiving 'a detailed lecture on the importance of computer[s] for developmental planning in India'.[76] He was among the first engineers to work on the HEC-2M:

> The keys were like electrical switches. We had to toggle them to enter commands or write a programme. The machine's memory was minuscule—it had only a 16-bit word length and a 1,024-word memory. There was a panel with rows of miniature neon lights, each representing a digit and the bulbs would light up one by one once the computer solved a problem. We would scramble to decipher the answer.[77]

Apart from processing data related to the National Sample Survey, and performing calculations for various divisions within the Indian Statistical Institute, computational requests were received from scientific institutions across the country.[78] The 'biggest problem' that the computer tackled, however, was a mathematical one sent by the

[75] M. Mukherjee, 'The first computer in India', in *Computer Education In India*, Dr U. K. Banerjee (ed.), Concept Publishing Company, New Delhi, 1996, pp. 13–15.

[76] D. D. Majumder, 'Foundation of Information and Computer Technology (ICT) in India and the Indian Statistical Institute (ISI)', http://csidl.org/bitstream/handle/123456789/119/Computing%20in%20Kolkata.pdf?sequence=1 [accessed 4 December 2015], p. 8.

[77] J. Mazumdar, 'Deepest blue', *Outlook Magazine*, 10 December 2007, http://www.outlookindia.com/magazine/story/deeepest-blue/236202 [accessed 27 March 2017].

[78] These included the Indian Institute of Technology (Kharagpur), Indian Institute of Science (Bangalore), Indian Association for the Cultivation of Science (Calcutta), Physical Research Laboratory (Ahmedabad), Tata Institute of Fundamental Research (Bombay), Andhra University (Waltair).

Planning Division at the Indian Statistical Institute.[79] As the first electronic computer in India and the first in Asia outside Japan, the digital computer was also a tourist attraction for 'ministers and other dignitaries' who visited the Indian Statistical Institute.[80] But, as Mahalanobis had noted before its purchase, the HEC-2M was never going to meet the computational needs of the National Sample Survey and economic planning. It was ultimately a training device, bought 'mainly to obtain operational experience of using and maintaining a general-purpose electronic computer'.[81]

While the Indian Statistical Institute was in the process of purchasing and installing its first digital computer, it had also begun inviting computer experts to help with the considerably more ambitious project of building one on site. When the Professor had visited the Institute of Precision Mechanics and Computer Engineering in Moscow in July 1954, he had resolved to bring Vitalii Ditkin, the institute's Deputy Director, to Calcutta by the year's end.[82] Between November and December 1954, the Indian Statistical Institute played host to four Soviet scientists—Vitalii Ditkin, D. Y. Panov, V. A. Melnicov, and A. N. Zimarev—who were deputed by the Soviet Union Academy of Sciences to advise the institute on 'the design of an electronic computer'.[83] The idea, as Mahalanobis saw it, was that the 'USSR would help our engineers to design and build an electronic computer to suit our special needs'.[84]

The plan to build a digital computer indigenously at the Indian Statistical Institute began in early 1954 and stumbled within months of having been announced. Talks with the visiting Soviet computer experts had given the laboratory pause. Designing and constructing a new computer, the Indian engineers quickly realized, would take several years. It made better sense to focus on operationalizing the HEC-2M and acquiring another computer from abroad.[85] Meanwhile,

[79] 'Electronic Computer Laboratory', *Samvadadhvam*, vol. 1, no. 2, October 1956, p. 32.
[80] Mukherjee, 'The first computer in India', p. 15.
[81] 'Indian Statistical Institute: Electronics Computer Division', dated 29 January 1960, Record No. 74, PCMMMA.
[82] Letter from PCM to Pant, sent from Moscow, 7 July 1954, Pitambar Pant Papers, NMML.
[83] D. Y. Panov was the retired Director of the Institute of Precision Mechanics and Computer Engineering. Melnicov and Zimarev were electronic engineers. Indian Statistical Institute: 'Twenty-third Annual Report', p. 162.
[84] Note by PCM on 9 June 1959, Record No. 72, PCMMMA.
[85] Indian Statistical Institute, 'Twenty-fourth Annual Report, p. 266.

the United Nations Technical Assistance Administration deal that Mahalanobis brokered with the Soviet Union had jumped through the requisite bureaucratic hoops and found approval. The Indian Statistical Institute lost little time in initiating a request to the United Nations Technical Assistance Administration through the Indian government for a 'large electronic [Soviet] computer URAL ... machine tools, instruments and equipment for the repair, maintenance and development of electronic computers'.[86] The Indian Statistical Institute expected to receive the URAL by the end of 1956, but its shipping was delayed by almost two years.[87] It was formally handed over to the Indian Statistical Institute on 20 December 1958 at the end of a conference inaugurated by T. N. Singh, a member of the Planning Commission. The following day, the *Times of India* reported that this computer could work '600 times faster than a single man'.[88] The Indian Statistical Institute had laid claim to the distinction of possessing the only two digital computers in South Asia. Eight Soviet engineers followed the arrival of the URAL and it took them three months to install it in an air-conditioned room.[89] Unlike the HEC-2M, the URAL arrived with detailed manuals of instructions: unhelpfully, they were in Russian. Soviet engineers held classes with the help of an interpreter on construction, operation, and maintenance of the computer.[90] Indian engineers also scrambled to learn some Russian.[91] Soon, the URAL was running two shifts a day and, when not involved in tasks relating to the Indian Statistical Institute's priorities (the National Sample Survey and planning), its time was contracted out to other Indian institutions.[92] By 1959, the institute's Electronic

[86] The URAL was designed by Bashir Rameyev, who had left the STRELA project after the first of the series was completed to head the computer centre in Pensa where the URALs were produced. 'Indian Statistical Institute: Electronics Computer Division', dated 29 January 1960, Record No. 74, PCMMMA.

[87] The URAL was formally transferred to the Government of India. It was on loan to the Indian Statistical Institute, but the government continued to 'retain complete freedom to utilize the equipment at their discretion'. Note prepared by PCM and 'handed over to the Prime Minister for his information', dated 4 March 1959, Record No. 119, PCMMMA.

[88] 'Quality control talks begin in Calcutta', *Times of India*, 21 December 1958, p. 7.

[89] 'Soviet electronic computer—URAL', *Samvadadhvam*, vol. 2, no.4, July–September 1958, p. 22.

[90] Ibid., p. 22.

[91] Rajaraman, *History of Computing*, p. 16.

[92] These included Andhra University, Benaras Hindu University, Defence Science Laboratory, Directorate of Meteorological Observatories, Hindusthan Aircraft, Indian Institute of Science, Indian Institute of Technology (Kharagpur), the Ministry of

Computer Division employed a staff of 30. The 'important work' the computers were used for included 'scrutiny of data, calculation of standard errors, and supply of random numbers for National Sample Survey Division . . . and . . . optimal solutions of problems of industrial and economic planning for the Planning Division'.[93]

The one that got away . . .

By 1959, the Indian Statistical Institute had secured two digital computers—from the United Kingdom and the Soviet Union—and served as the de facto national computation centre in India. It was apparent, though, that the institute's computing capabilities required augmenting. This had even been the substance of a recommendation made in the Report of the National Sample Survey Review Committee (1957). Headed by English statistician Sir Ronald Fischer, the committee recommended increasing the use of electronic computers because neither of the computers that the Indian Statistical Institute had was 'suitable for full scale work of the NSS type'.[94] They believed that the 'actual and potential work load' was 'sufficiently large to justify the installation of a large computer'.[95] The Indian Statistical Institute had been after such a computer for more than a decade. If the HEC-2M and URAL were quests fulfilled, the saga of the American UNIVAC was one of unrequited interest.

Mahalanobis had first expressed an interest in this machine as early as 1948, when its manufacture had only just begun. The UNIVAC was unveiled in March 1951 when Eckert and Mauchly handed it over to the United States Bureau of Census. It acquired national celebrity in November 1952 when it starred alongside Walter Cronkite on CBS during election night and accurately predicted Dwight D. Eisenhower's surprising landslide victory in the United States presidential elections

Defence, Institute of Armament Research, Physical Research Institute, the Saha Institute of Nuclear Physics, Tata Institute of Fundamental Research, and the Atomic Energy Commission. 'Indian Statistical Institute: Electronics Computer Division', dated 29 January 1960, Record No. 74, PCMMMA.

[93] Indian Statistical Institute, 'Twenty-seventh Annual Report, April 1958–March 1959', http://hdl.handle.net/10263/1899 [accessed 11 April 2017].

[94] The other members of this committee were Morris. H. Hansen (United States), T. Kitagawa (Japan), A. Linder (Switzerland), and Frank Yates (United Kingdom).

[95] P. C. Mahalanobis, 'Indian Statistical Institute: National Sample Survey Review Committee Report', *Sankhyā: The Indian Journal of Statistics, Series B (1960–2002)*, vol. 26, no. 3/4, December 1964, p. 331.

over Adlai Stevenson.[96] It also became one of the first computers to drift into popular culture: in the 1950s, UNIVAC became a byword for computers amongst the American public. It would go on to feature on the cover of an issue of the *Superman* comic and in a Wile E. Coyote cartoon (where it was used to help ensnare Bugs Bunny).[97] By 1954, when Mahalanobis and Mitra visited America and made enquiries about computers, the Professor had been trying to acquire a UNIVAC for years. Its cost had made outright purchase impossible. As a result, in order to route it through some form of technical aid, he directed his efforts at the United States Technical Cooperation Mission to India (TCM), which was part of the United States Technical Cooperation Administration. Despite his doggedness—tugging like a pit bull terrier at the pant leg of aid agencies for more than a decade—he never succeeded. It appears that India was unable to get a digital computer from the United States through the 1950s partly because of Mahalanobis's reputation as a Soviet sympathizer during the Cold War. India, like the Professor, remained unaware that the person spearheading the campaign to bring computers to India was himself an obstacle.

Between 1950 and 1954, Mahalanobis had engaged in numerous informal discussions in Washington regarding the provision of technical aid to India, specifically relating to 'Electronic computers of large capacity'.[98] According to him, the decision to ask the Soviet Union for similar technical aid was precipitated by receiving 'no response' from the Americans.[99] Unbeknownst to him, it was Mahalanobis's notoriety at the American State Department that had frozen talks. A dispatch from the American Embassy in New Delhi to the State Department in the summer of 1953—classified as 'Secret Security Information'—reflects the ominous light in which the Professor was viewed. The dispatch pointed out that the State Department already possessed files that made it evident that he was

[96] This was the first presidential election that was broadcast on television coast to coast. It was also the first time that computers were used to help anticipate the results of an election. S. Henn, 'The night a computer predicted the next president', *NPR*, 31 October 2012, http://www.npr.org/sections/alltechconsidered/2012/10/31/163951263/the-night-a-computer-predicted-the-next-president [accessed 27 March 2017].

[97] Ibid.; 'Superman's girlfriend Lois Lane, comic featuring UNIVAC on the cover', Object ID 500004046, Computer History Museum, http://www.computerhistory.org/revolution/early-computer-companies/5/102/446 [accessed 27 March 2017].

[98] Note made by PCM on 9 June 1957, Record No. 72, PCMMMA.

[99] Ibid.

a 'notorious fellow traveller and sympathizer of the Soviet Union and that his Indian Statistical Institute functions in part as a Communist apparatus'.[100] This reputation was most likely the result of having made two visits to the Soviet Union, being identified as an admirer of the pace of Soviet economic growth, and for being seen as an advocate for rapid industrialization and an expansion of the public sector. A few days later, the American consul, Garrett H. Soulen, sent a confidential letter to Washington from Calcutta corroborating this view. The letter contained a record of a conversation between Mahalanobis and Dr Harry D. Gideonse, President of Brooklyn College. The value of this memorandum, the letter claimed, lay in the insight it provided into Mahalanobis's political loyalties from a new and independent source.[101] Gideonse met with Mahalanobis on 30 July in Calcutta and spoke with him for two hours (the duration being mainly the result of the Professor's 'native love for what he calls "skirmishing"'). It began rather well for the Professor; Gideonse opened by saying 'Mahalanobis is a person of exceptional personal charm and broad cultural background'. After that, however, it was mostly downhill. He described the Professor as someone who was convinced that the Soviet Union had peaceful objectives, unlike 'many Americans'. Gideonse concluded: 'To me, Mahalanobis is far more significant than straight communist propaganda. He has personal and moral authority, apparent integrity, and an impressive command of relevant information. His ideas are in my judgment a direct preparation for an authoritative solution to India's economic problems.'[102] By the end of following year, Mahalanobis had certainly become a liability in the attempt to convince Americans of India's need for technical aid in the form of a computer. Another confidential memorandum sent from the United States Embassy in Delhi to the Department of State confirms that:

> The problem of P.C. Mahalanobis . . . is well known to the Department . . . . Apparently Professor Mahalanobis has been trying to secure both electronic calculating equipment and technical assistance from either the United States or the USSR . . . . It will be noted that the present position of the Embassy

[100] 'Professor P. C. Mahalanobis', 30 July 1953, Desp. No. 192, Confidential U.S. State Department Files, India 1950–54, Internal Affairs, RG 59, General Records of the Department of State.

[101] 'Professor P. C. Mahalanobis, Chief of the Indian Statistical Institute', 7 August 1953, Desp. No. 115, Confidential U.S. State Department Files, India 1950–54, Internal Affairs, RG 59, General Records of the Department of State.

[102] Ibid.

and TCM/India is not to give any assistance to the Indian Statistical Institute because of Professor Mahalanobis' reputation of being at least a fellow traveler.[103]

Unsurprisingly, nothing came of the Professor's negotiations with the Technical Cooperation Mission. It also appears that he remained in the dark about his own unwitting role in stymieing the progress of the UNIVAC proposal.

By early 1957, there had been a change of either heart or strategy with regard to the Professor and the Indian Statistical Institute—at least among American officials in New Delhi. The Technical Cooperation Mission office in Delhi considered and forwarded to Washington a project worth $1.5 million in favour of the Indian Statistical Institute—a million for the UNIVAC and half a million for the cost of training over two to three years.[104] Much to the Professor's chagrin, the proposal was once again turned down in Washington. He was informed that the disapproval was based on the assessment that, although desirable, 'it is not of sufficiently high priority to justify such a large expenditure'.[105] A letter from Ambassador Bunker during the summer of 1957 suggests that, this time, even the Embassy in New Delhi was dissatisfied with the outcome. According to the letter, the real reason John Hollister, Director of the International Cooperation Administration (ICA), had 'turned down the UNIVAC machine for Mahalanobis [was] on the ground that with all the unemployment in India spending a million dollars on a fancy calculating machine cannot be justified'.[106]

Annoyed, and no doubt puzzled, by Washington's repeated unwillingness to part with a computer, the Professor was, however, undeterred. He now looked toward the Ford Foundation, communicating with Douglas Ensminger, the Ford representative in India, to enquire about the Ford Foundation's willingness to offer the Indian Statistical Institute a grant or loan to purchase

[103] 'United States and USSR economic interests in India', 12 November 1954, Desp. No. 536, p. 2, Confidential U.S. State Department Files, India 1950–54, Internal Affairs, RG 59, General Records of the Department of State.

[104] Note by PCM on 'Electronic processing facilities for the Indian Statistical Institute: informal discussions with the American Embassy', dated 19 April 1957, Record No. 72, PCMMMA.

[105] Letter from Donald H. McClelland (Economic Advisor, Program) to Professor P. C. Mahalanobis, dated 24 May 1957, Record No. 72, PCMMMA.

[106] The ICA was a successor to the United States FOA. John Hollister was Eisenhower's conservative pick for Directorship of the ICA. It was viewed in America as a blow to those in favour of greater aid.

the UNIVAC.[107] That autumn, some of the Professor's friends in America—Morris Hansen, Samuel Alexander, and Russell Ackoff (all of whom had spent time at the Indian Statistical Institute)—wrote to the President of the Ford Foundation in their personal capacities echoing that suggestion. They explained that the Indian Statistical Institute was responsible for 'collecting, tabulating and analyzing much of the social and economic data which provides the basis on which India's plans are prepared and progress is evaluated'. And, while the people charged with this work are of the 'highest order', they contended with 'severe handicaps'—insufficient electronic data-processing machinery looming large among them. Presenting the Indian Statistical Institute with a computer like the UNIVAC 'not only would aid India in its planning and development, but would contribute greatly toward building a stronger bond between India and our own country'.[108] Learning of this letter, a 'deeply touched' Mahalanobis told Hansen that the gesture was 'a mark of the concern which the best minds of America feel for an underdeveloped country like India'.[109] The letter did have the effect of beginning a dialogue between Douglas Ensminger and the Ford Foundation headquarters about the possibility of awarding the Indian Statistical Institute a direct loan of a million dollars (repayable in rupees) for the purchase of a UNIVAC. The Ford Foundation responded saying that a direct loan was not legally possible. However, allowing a glimmer of hope, it stated that all future money from the Ford Foundation to India could, in theory, be directed towards the purchase of a computer—if all Indian agencies agreed to this arrangement internally.

Two years later, little had changed. Mahalanobis was still thanking Morris Hansen and Samuel Alexander for their 'continuing efforts' and continued lamenting India's inability to purchase the machine due to the scarcity of foreign currency and the difficulty in procuring an import license. The Professor bemoaned the lack of appreciation in India for its own scientific needs. National Sample Survey data—of 'great importance for economic development'—was being held up

[107] This was part of a grant request for a variety of items—the purchase of books and equipment from abroad, and the funding of travelling fellowships. Letter from PCM to Dr Douglas Ensminger on 5 December 1957, Record No. 72, PCMMMA.

[108] Copy of a letter sent from Morris H. Hansen, Samuel N. Alexander, and Russell L. Ackoff to Dr Henry Heald (President, The Ford Foundation), dated 26 November 1957, Record No. 72, PCMMMA.

[109] Letter from PCM to Morris Hansen, dated 11 December 1957, Record No. 72, PCMMMA.

because of an amount 'very small in comparison to the hundreds of millions of dollars which are being made available to India from USA'. You can almost hear the desperation when he writes to his friend in Washington wondering, yet again, whether 'there is any possibility of ICA (or some Foundation or other) considering a loan or a gift for this purpose?'.[110] Another two years later, nothing had budged on the American front.

Losing favour

By 1960, the Indian Statistical Institute had lost the distinction of being the only centre for computers in India. The Tata Institute of Fundamental Research (henceforth, 'the Tata Institute') in Bombay had, under the direction of Homi J. Bhabha, stolen a march in the quest for the first indigenously built digital computer.[111] The project had been initiated in 1955, at the same time as the Indian Statistical Institute harboured similar designs. But, unlike its competitor in Calcutta, and perhaps because it was not able to import computers, the computer programme in Bombay was not abandoned. The computer became operational in 1959 and started being used the following year, though it would acquire a name only in 1962 when Nehru christened it TIFRAC (Tata Institute of Fundamental Research Automatic Computer). By the time it had been named, however, developments in computer technology in the rest of the world had left the TIFRAC, in the words of its principal designer, 'an obsolete first generation machine'.[112] As a result, the Tata Institute was also soon on the market for the import of another computer. The arrival of the Tata Institute as another player in the Indian computing scene led to a bureaucratic tussle between Mahalanobis and Bhabha over whose institution would be granted a computer through government funds. Like the Professor, Bhabha also wielded considerable sway with the government. Apart

[110] Letter from P. C. Mahalanobis to Morris Hansen dated 11 July 1959, Record No. 72, PCMMMA.

[111] It is noteworthy that, like Mahalanobis, Bhabha too had been inspired by Jon von Neumann's path-breaking computer design in the late 1940s. Bhabha learnt of it during a visit to Princeton University, and he brought back a report of von Neumann's design to India. Shyamsundar and Pai, *Homi Bhabha*, p. xxv.

[112] Ibid., p. xxv.

from having Nehru's ear and being the Director of the Tata Institute, Bhabha was also the Chairman of the Atomic Energy Commission.[113]

In August of 1961, Bhabha wrote to Mahalanobis saying he was aware of the Indian Statistical Institute's request to the government for the purchase a computer, and informed the Professor that the Tata Institute had similarly proposed the installation of a 'powerful computer' as part of the Third Five-Year Plan. He concluded the letter by suggesting that they make common cause: 'We should jointly press for both computers and I have a feeling that we will succeed in getting two from the Americans under TCM or under some other agency.'[114] Bhabha had obviously not shared the Professor's history of rejection from American agencies. When Mahalanobis responded, he made sure to put into perspective their relative claims. He pointed out that the proposal to bring a computer to work primarily on National Sample Survey data had been initiated by the Indian Statistical Institute years ago, in 1957. Computers were urgently needed for this purpose and 'a timely flow of economic information would become increasingly of crucial importance for the efficient functioning of the planned economy'. Acknowledging that he would be glad to join forces, he nonetheless added pointedly that 'If for any reason, two computers are not available, I should have no hesitation in giving a higher priority to the data processing equipment for the National Sample Survey'.[115]

In the spring of 1962, Tarlok Singh, a Planning Commission member, wrote a short article stating that, before long, it would become 'necessary to establish modern high speed computational facilities which are readily accessible to the Planning Commission and the Central Statistical Organisation'.[116] A few days later, Mahalanobis spoke in person with Gulzarilal Nanda (Planning Commission member and Minister of Planning) about this 'excellent idea'. While any proposal for a computer excited him, this one also left him nervous about the possibility of the Indian Statistical Institute being edged out of the equation. Later that day, he followed up with a letter in which he

[113] It is worth noting that, until the computer was developed in Bombay, the secret calculations for the Atomic Energy Project were sent to Calcutta to be solved at the Indian Statistical Institute's computers.

[114] Letter from Bhabha to Mahalanobis dated 22 August 1961, Record No. 72, PCMMMA.

[115] Letter from Mahalanobis to Bhabha dated 25 August 1961, Record No. 72, PCMMMA.

[116] 'Studies in long-term economic development—tentative scheme of work', note prepared by Tarlok Singh dated 27 April 1962, Record No. 73, PCMMMA.

tried to prevail on Nanda to allot the facility to the Indian Statistical Institute. Reminding him of the history of the Indian Statistical Institute's involvement in advancing India's computer capabilities and its service in training personnel in programming, he reasoned that the Indian Statistical Institute was the natural home for such a facility. The institute had also recently been granted office space in Delhi—an appropriate location to 'maintain a large electronic computer in Delhi in collaboration with the Planning Commission and the Central Statistical Organisation in the same way as the Institute has been working in the field of planning since 1954'.[117]

At an informal summer meeting in Yojana Bhavan—the Planning Commission's headquarters—there was a discussion over this proposal for a new national computing centre. It was decided that a committee would be set up to report within six weeks on the types of computers that would be required and the agencies to be entrusted with it. Members of this committee belonged to organizations most interested in computers—the Indian Statistical Institute, the Tata Institute, the Central Statistical Organization, the Department of Atomic Energy, and the Planning Commission. The Chairman of the Committee, to his relief no doubt, was Mahalanobis.[118] He was unambiguous about the need for more computers—a 'matter of urgency for economic development as well as national defence'—and continued to argue that the Indian Statistical Institute should host the data-processing computer on either its Calcutta or its Delhi premises.[119] It made most sense to award another computer to the Indian Statistical Institute, he believed, because it had a history of running such machines and a nucleus of personnel trained in doing so.[120] To add weight to his claim, he quoted the Cabinet decision made on 29 July 1952 that 'the project

[117] Letter from Mahalanobis to G. L. Nanda dated 30 April 1962, Record No. 119, PCMMMA.

[118] Minutes of the meeting held on 7 June 1962 in Room No. 126, Yojana Bhavan, New Delhi, Record No. 73, PCMMMA. It would appear that the Indian Statistical Institute and the Tata Institute came to some sort of agreement because, when the Professor wrote to Tarlok Singh of the Planning Commission that winter, he agreed with Bhabha's proposal for two computers to be sanctioned by the government—one for each of their institutions. The Professor added that, apart from the request for a large computer, the Indian Statistical Institute also required another smaller computer for 'immediate needs, especially for the processing of urgent economic information required by the Planning Commission'. Letter from PCM to Shri Tarlok Singh dated 27 November 1962, Record No. 73, PCMMMA.

[119] Letter from PCM to Shri Tarlok Singh dated 27 November 1962, Record No. 73, PCMMMA.

[120] Ibid.

section of the Indian Statistical Institute should be worked on the line of a National Statistical and Computation Laboratory'. He also made reference to the Act passed in parliament in 1959 that had declared the Indian Statistical Institute an institute of national importance, allowing it to award degrees, and bringing it into the public sector.[121]

The Indian Statistical Institute was ultimately not granted the large data-processing computer that Mahalanobis had been after. He and the Indian Statistical Institute might have been somewhat mollified, however, at being granted a license to import a smaller computer, the IBM 1401—though the government did not offer any grants for its purchase either.[122] The institute had been toppled from its perch of exclusivity: during these years, other institutions and corporations in India acquired their own computers. Esso Standard Eastern of Bombay installed the country's first commercial computer in 1961. By the following year, the Defense Ministry had set up its own computer centre. In August 1964, the Indian Institute of Technology at Kanpur, which had been established through assistance from the United States Agency for International Development (USAID), received an IBM 1620—a computer that was then being used in many American universities. IIT Kanpur soon gained a reputation as a centre for computer education as its faculty began offering tri-annual courses on programming for engineers and scientists across the country.[123]

[121] Ibid.

[122] It is possible that the large computer of a UNIVAC type was not sanctioned because the Indian Statistical Institute had in 1962 already begun collaborating with Jadavpur University to build a second-generation digital computer. This computer, named ISI-JU, was completed in 1966, but was an unsuccessful project because the computer was unreliable and lacked the required software. Rajaraman, *History of Computing*, pp. 16–17.

[123] The United States Agency for International Development's funds were channelled through the Kanpur Indo-American Programme (KIAP)—a consortium of nine American universities that assisted IIT Kanpur through the provision of equipment and visiting faculty. In setting up the computer, IIT Kanpur had the help of scientists from the United States—Harry Huskey (U.C. Berkeley), Forman Acton (Princeton University), and Irving Rabinowitz (Princeton University). IIT Kanpur was one of four IITs that received foreign assistance. The Soviet Union provided support to IIT Bombay (1958), West Germany to IIT Madras (1959), America to IIT Kanpur (1960), and Britain to IIT Delhi (1963). See V. Rajaraman, 'Impact of computer science education: IIT Kanpur on information technology in India', in Shyamsundar and Pai, *Homi Bhabha and the Computer Revolution*; R. Bassett, 'Aligning India', pp. 783–810. For Harry Huskey's recollection, see 'Oral history of Harry Huskey', Reference number: X3455.2006, Computer History Museum, pp. 41–2, http://archive.computerhistory.org/resources/text/Oral_History/Huskey_Harry/Huskey.oral_history.2006.102657983.pdf [accessed 27 March 2017].

Possibly due to the priority granted to the atomic energy project on which the Tata Institute was working, Bhabha managed to persuade the government and within two years his institution was in possession of a CDC 600.[124] At the Tata Institute, the addition of the 'largest computer commercially available' propelled it to the status of a national computing centre, like the Indian Statistical Institute.[125] As a national facility, it handled requests from scientific, engineering, and educational institutions. Even the Planning Commission said that it would be of 'vital assistance' to its work. By the end of 1964, there were at least 15 computers in operation in India, and the numbers would grow rapidly over the course of the decade. The Indian Statistical Institute was not the only computation centre in the country anymore, and it had also lost its exclusive association with the handling of planning data. The next year saw the realization of what the Professor dreaded. If the rise of a computing centre in Bombay de-centred the Indian Statistical Institute's computer programme, the installation of one at Yojana Bhavan marginalized it.

By 1963, the Ford Foundation had come around to the view that awarding India a computer was worthwhile. An inter-office memorandum addressed to Douglas Ensminger stated that installing a computer would 'contribute significantly to National Planning and Defence'. With the Government of India's growing appetite for statistics, a computer would 'aid in planning and in the management of activities designed to implement the plan'.[126] It was clearly assumed that the computer would be located in Delhi and run by the Indian Statistical Institute. Ensminger forwarded this memorandum to Tarlok Singh, who passed it on to Mahalanobis. The Professor repeated the well-rehearsed arguments in favour of the Indian Statistical Institute as the operating agency.[127] But, despite the cajoling, it did not end in the Indian Statistical Institute's favour. Over the course of

[124] The CDC 600 (manufactured by Control Data Corporation) was installed at the Tata Institute in May 1964. It was acquired at the cost of $1.5 million and was financed through a loan to the Government of India by the United States Agency for International Development (AID). As in the case of the HEC-2M at the Indian Statistical Institute, the Tata Institute sent engineers to the Control Data Corporation United States to learn how to use and maintain the machine. Rajaraman, *History of Computing*, p. 17; 'Bombay's versatile computer', *Times of India*, 7 February 1965, p. 6.

[125] 'Computer: magic tool of future', *Times of India*, 3 September 1964, p. 6.

[126] Letter from Dr Forrest E. Linder and Dr Conrad Tauber to Dr Douglas Ensminger dated 21 January 1963, Record No. 73, PCMMMA.

[127] Letter from Mahalanobis to Tarlok Singh dated 3 February 1963, Record No. 73, PCMMMA.

the next two years, the Indian Statistical Institute slowly drifted out of the frame. In the autumn of 1965, computer centres funded by the Ford Foundation were opened in New Delhi. They were the outcome of Ford Foundation grants made that summer to four institutions—Delhi School of Economics, University of Bombay, Institute of Agricultural Research Statistics, and the Planning Commission.[128] On 23 September, Asok Mehta (Deputy Chairman of the Planning Commission) inaugurated a computer centre at Yojana Bhavan, effectively closing the door on the Indian Statistical Institute's hopes of remaining the Planning Commission's central computational arm.[129]

The story of the computer's history in India still remains incomplete. But, as this article has argued, it certainly cannot be narrated without planning playing a sizeable part. Unlike most countries in which computers were used in the mid-twentieth century, the first use of the computer in India was in service of the developmental state—not the military. The person principally responsible for its adoption, Mahalanobis, explicitly invoked planning in his justification for why it was worth investing in. And the institution that would host the first computers, the Indian Statistical Institute, used them primarily to process and tabulate data that were essential to the planning process. Their potential for planning was also why the Government of India

[128] '1620 computer installations for New Delhi area', Record No. 017762, Unpublished Reports, Ford Foundation Papers, Rockefeller Archive Center, Sleepy Hollow.

[129] 'Computer centre is opened', *Times of India*, 24 September 1965, p. 5. The Ford Foundation grant to the Project Evaluation Organization of the Planning Commission was worth $462,000 (approximately 23,00,000 rs). It was used by the Planning Commission to purchase a medium-sized electronic computer—an IBM 1620—and ancillary equipment. The Computer Centre worked on a 'open shop' basis—outside users were charged fees based on a 'no profit no loss' calculation. The National Council of Applied Economic Research (up to 30 per cent of the time) and other government departments utilized the facility in this manner. The lack of trained staff and 'teething troubles' meant that the computer could be used for only one shift in a day until 1968, when improvements allowed a two-shift operation (an average of 13 hours a day). The demand for the services of the computer centre was twice what was available. By 1971, the computer system at Yojana Bhavan was obsolete and prone to breaking down. In January 1971, an Expert Committee was appointed to look into how the system could be replaced. As an official file noted, 'the importance of having a modern computer facility in the Planning Commission ... cannot be overemphasized. Planning and Development admittedly deserves the highest priority, and, therefore, the proposal to install a suitable computer system in the Planning Commission may be accorded high priority'. The committee recommended that approximately $0.6 million of the funds earmarked for India by the United Nations Development Programme be used to modernize the computer system. F. No. 9/51/71 RSR, Planning Commission, National Archives of India, New Delhi.

even sanctioned their purchase in the 1950s—even though million-dollar commitments were a considerable strain on a poor nation. The decision taken after independence to centrally plan the economy threw up a problem of big data. The computer's appeal was its promise as a solution.

Speaking from the ramparts of the historic Red Fort in New Delhi on 15 August 2014, turban aflutter in the summer breeze, the newly elected Prime Minister Narendra Modi announced the end of the Planning Commission in his Independence Day speech. On New Year's Day 2015, it was replaced by a new body—the NITI Aayog (National Institution for Transforming India). This followed months of speculation during which the commission had come under a hail of criticism. Planning had become old-fashioned and outdated, synonymous with cobwebbed ideas. Justifiably or not, it passed unlamented. What was overlooked in its eulogy was that, in the middle of the twentieth century, planning in India had been synonymous with technological advance. It had, in fact, paved the way for a digital modernity in South Asia.