Cryptographic imagination: Indus script and the project of scientific decipherment

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The success of the cryptographic technique during World War II in decoding enemy ciphers holds an enduring impact on archaeologists working on decoding ancient scripts. The conviction to break open any code, in theory, employing scientific methods, mathematical formulae and computers, gives rise to a cryptographic imagination*. This epistemological articulation apprehends the ancient script as a military cryptogram that could be cracked through scientific intervention. I examine cryptographic imagination within the decipherment of the Indus Script—the unknown script of the third millennium BCE Indus civilisation in South Asia. I specifically examine the decipherment attempts of the Finnish and the Russian teams during 1960s and 70s. By analysing the Finnish and Russian decipherment attempts, I argue that cryptographic imagination involves an epistemological shift of conceptualising unknown archaeological script from an* epigraphic *representation to a* cryptographic *code*.

Introduction

Since Jean-François Champollion's decipherment of the Egyptian hieroglyphics, the decipherment of ancient scripts has constituted the most challenging genre of

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archaeological enquiry.[1] In both popular and scholarly perception, the decipherment of an ancient script has been considered the most iconic of all archaeological puzzles and the successful decipherer as a uniquely brilliant mind.[2] Within the emerging disciplinarian framework of archaeology in the nineteenth century, decipherment of ancient scripts was categorised as a sub discipline of epigraphy and inscriptional studies. By the end of World War I, decipherment of ancient scripts had emerged as a dominant genre of archaeological enquiry. With the discovery of numerous undeciphered scripts, their importance flourished in understanding past cultures. Decipherers of various disciplinary configurations were attempting to decode these newly discovered writings. These attempts were met with varying degrees of success and frequent failures. The successful decipherment narratives were written as a victory of modern intelligence over the resoluteness of an ancient language. The failures indubitably reinforced the reputation of the undeciphered scripts as arduous riddles.[3]

Most successful decipherments before World War II constituted those ancient scripts where bilingual co-relates existed or were scripts of known languages.[4] Along with the Egyptian hieroglyphs, the decipherment of various Mesopotamian cuneiform scripts (Persian, Summerian, Akkadian, Elamite, Ugaritic), Cypriot syllabary, Hittite (Luvian hieroglyphs), South Asian Brahmi and Kharoshti scripts served as successful examples. These decipherments were epigraphic interventions—based on analogical and typological methods. The decipherment was undertaken through associative and correlative techniques: 'The decipherer

[1] For engaging accounts of the decipherment of the Egyptian hieroglyphics and the brilliance of Champollion, see Meyerson, *The Linguist and the Emperor*; Parkinson, *Cracking Codes: The Rosetta Stone and Decipherment*; Ray, *The Rosetta Stone and the Rebirth of Ancient Egypt*; Sole & Valbelle, *The Rosetta Stone*; Allen, 'The Predecessors of Champollion'. In popular accounts, Champollion has been credited to be the sole decipherer of the script; however a polymath Thomas Young also played an important role in the decipherment process. He had partially deciphered the script and created a conceptual framework, which helped Champollion in his final decipherment. For more details see: Adkins & Adkins, *The Keys of Egypt*; Robinson, *The Last Man Who Knew Everything*; Robinson, 'Thomas Young and the Rosetta Stone'.

[2] Maurice Pope influentially notes: 'Decipherments are by far the most glamorous achievements of scholarship. There is a touch of magic about unknown writing, especially when it comes from remote past, and a corresponding glory is bound to attach itself to the person who first solves its mystery' in Pope, *The Story of Decipherment,* p. 9.

[3] Two of the most popular narratives of successful decipherment are John Chadwick's *The Decipherment of Linear B* and Michael Coe's *Breaking the Maya Code*. Both these historiographical accounts were written as modernity's struggle against an ancient writing system. Tropologically, the scientific apparatus of modernity in these decipherment histories is the intervention rationality through which the enigmatic world of the pre-modern structure is eventually decoded.

[4] In Johannes Friedrich's *Extinct Languages*, he classified the decipherment of ancient scripts into three categories: unknown language written in known script (Hittite cuneiform and Etruscan); known language written in unknown script (Cypriote Greek) and finally the most difficult challenge—unknown language in an unknown script, pp. 151–52.

somehow got hold of an external clue which allowed the unraveling of an whole interwoven graphic and linguistics system'.[5] The decipherment project was envisioned as a problem to comprehend a linguistic entity inscribed in a graphic system. The methodological emphasis was on *recognition* rather than *decoding*. The epistemological framework for decipherment was unambiguously epigraphical; driven by the need to identify the meaning of symbols through analogical affiliation with the known graphic and linguistic universe rather than to crack open a mathematical code.[6] This methodological impetus in the decipherment project prior to World War II was a disciplinary vestige of the genealogical association of the decipherment practice with epigraphy and inscriptional analysis. The post-war era, however, witnessed an epistemic shift in the technological practice of decipherment of ancient script.

The extraordinary success of the military cryptographer during WW II in decoding the German ciphers as well as the breaking of the Enigma code influenced scholars involved in deciphering ancient scripts.[7] Simultaneously, the post war ascendancy of science played a significant role in renewed attempts at the scientific decoding of ancient scripts. For the first time there was not only epistemological but significant technological confidence to decipher ancient scripts without a bilingual support.[8] This added confidence could be attributed to the remarkable accomplishment of the military cryptographers during the WW II, who could break open any cipher by intricately analysing their structural formation, utilising mathematical, statistical, algorithmic formulas, enabled through the incipient introduction of pre-computers.[9] These technological advancements led to a conceptual shift in the way ancient scripts were perceived in archaeology.[10] Prior to such progress, undeciphered scripts were conceptualised as merely *(epi)graphic* representation of ancient linguistics system that had to be recognised through analogical

[5] Barber, *Archaeological Decipherment*, p. 21.

[6] For examples of numerous decipherments using epigraphic techniques see Pope, *The Story of Decipherment*; Cottrell, *Reading the Past*; Dobhofer, *Voices in Stone*; Robinson, *Lost Languages*.

[7] Military narrative of cryptanalysts success is vast, but especially see Budiansky, *Battle of Wits*; Freedman, *Unravelling Enigma*; Copeland, ed. *Colossus*; Alvarez, *Allied and Axis Signals Intelligence in World War II*; Bauer, *Decrypted Secrets*; Garlinski, *The Enigma War*; Haufler, *Codebreakers' Victory*; Kahn, *Seizing the Enigma*; Kozaczuk, & Straszak, *Enigma: How the Poles Broke the Nazi Code*; Winkel, *The German Enigma Cipher Machine.*

[8] See Barber, *Archaeological Decipherment*; Gelb, 'Method of Decipherment'; David Kahn, *The Codebreakers*.

[9] The history of computers and cryptography is intricately linked. The world's first programmable, digital, electronic, computing device—'Colossus' was manufactured by the British during World War II to break German codes and was a product of engineers and Bletchley Park cryptographers. For an extensive historical account of the relationship between World War II code breaking and computers see Copeland, *Colossus*.

[10] Barber, *Archaeological Decipherment*; Kahn, *The Codebreakers*; and Singh, *The Code Book* unequivocally note the association between post WW II military cryptanalytical methods and the post-war practice of the decipherment of ancient scripts.

analysis. After the cryptological triumph of WW II ancient scripts were viewed as *(crypto)graphic* code to be cracked: a cryptosystem.[11] Now decipherers attempted to decode ancient scripts with a *cryptographic imagination*—an epistemological intervention that did not comprehend the signs of the ancient script as individual pictogram or an ideogram but apprehended the script as a military cryptogram.[12] This cryptographic imagination involved a cryptanalytic framework that employed mathematical and statistical formulation of the military code breakers.[13] Simultaneously, archaeological cryptanalysts articulated their intervention as a rigorous scientific practice. Dobhofer in 1957 acknowledged this process in characteristic military rhetoric:

> Let us look at three of the latest problems, which so far have put up a stubborn resistance to all investigations. Two of them—Etruscan and the writing of Easter island—are as bastions already breached: the outpost and battlements have fallen, but citadel resists all attacks. The third, the Indus Valley script, is a fortress against which all assaults have been repulsed, whether in mass or single attacks.[14]

Undeciphered ancient scripts were now viewed as *ciphertext*—exclusive cryptological structures—devoid of any analogical graphic or linguistic associations, reduced to numerical abstraction.[15] Through this numerically essentialised formation, statistical frequency analysis was conducted to decipher patterns. The

[11] In 'Method of Decipherment', Gleb used the term cryptosystem to designate ancient undeciphered scripts. The script as a cryptogram is viewed as a complex system of signifier bound in secrecy. It displays all characteristics of similar systems like locks, disguises or extreme form of silence, which requires its key, eavesdropping mechanism or an unveiling operation to decipher. Kahn, *The Codebreakers*, p. 753.

[12] I borrow the term 'cryptographic imagination' from Shawn Rosenheim's *The Cryptographic Imagination*. Rosenheim provocatively suggests that modernity is infused with a cryptographic epistemology that defines our relationship with language and communication. From telegraphy to Internet, through the code breakers of World War II, a cryptographic subtext mediates modernity's structure of knowledge production. He locates the genealogy of this particular form of linguistic mediation to Edgar Allan Poe's cryptographic writing in the nineteen century and examines its political, ideological, epistemological and affective valence within the context of poststructuralist literary criticism.

[13] In David Kahn's extraordinary history of cryptography, *The Codebreakers*, he notes that the skill applied in cryptographic decipherment is both an art and science. The ability to encrypt he suggests is clearly dependent upon individual brilliance, especially those gifted with 'cipher brains'. Kahn, *The Codebreakers*, p. 754.

[14] In Dobhofer, *Voices in Stone,* p. 294.

[15] Theorising Poe's science fiction writing, Rosenheim emphatically notes that cryptography is predicated by the sense of the 'sign's apocalypse (from *apo-calyptos*, to unclose or discover), in which the crypt of the letter is shattered and immediate communication becomes the basis for unfettered self-realization and sociality', (italics in the original). Rosenheim, *The Cryptographic Imagination*, p. 89.

decipherers employed technological imagination of cryptanalysis that had been successful against enemy codes to break open the *enigma* of the ancient world. The script as a cryptogram was understood as a system of mathematical signifier bound in a crack-able code. The decipherment of this code required a cryptographic formula rather than an epigraphic cognate to comprehend it. The cryptographic imagination worked as a systematic knowledge production mechanism. Therefore, it shifted the epistemic emphasis of the decipherment practice from recognition of a graphic or linguistic cognate to cracking of a mathematical problem—the cryptological ciphertext.

It was with the success of Michael Ventris's decipherment of the Linear B in 1953 without a bilingual script that the cryptographic imagination permeated into the decipherment project. Ventris's work convinced archaeologists that it was possible to decipher an ancient script through careful and detailed scientific analyses of the internal features of available evidence. Central to Ventris's work was the cryptological conviction that in principal any code can be broken, provided sufficient evidence is available. Ventris's close collaborator John Chadwick, a military cryptographer during WW II, broke Italian and Japanese cipher in Bletchley Park before he became an archaeologist. In his famous account of the decipherment of Linear B, Chadwick elucidates the cryptographic imagination at work during Linear B's decipherment:

> Cryptography is a science of deduction and controlled experiments; hypotheses are formed, tested and often discarded. But the residue which passes the test grows and grows until finally there comes a point when the experimenter feels solid ground beneath his feet: his hypotheses cohere, and fragments of sense emerge from the camouflage. The code 'breaks'.[16]

In this article, I specifically examine Chadwick's cryptographic conviction. My research is located at a very specific historical moment of the decipherment of the Indus script—the unknown script of the Indus Civilisation.[17] This ancient culture is regarded as one of the greatest civilisations of the ancient world (third millennium BCE) along with the Egyptian, Mesopotamian and Chinese civilisations. Today the undeciphered Indus script has the reputation of being the 'biggest challenge of all in archaeological decipherment'.[18] The cryptographic imagination

[16] Chadwick, *The Decipherment of Linear B*, p. 57. Also see Ventris & Chadwick, eds. *Documents in Mycenaean Greek*; Robinson, *The Man Who Deciphered Linear B*; Ventris, Sacconi & Chadwick, *Work Notes on Minoan Language Research*.

[17] I continue to use the term Indus script in the article, although recently Farmer et al. have provocatively challenged its linguistic nature. See page 167 for more discussion on their claim.

[18] Robinson, *Lost Languages*, p. 265. An Indus archaeologist notes: 'The Indus writing system is among the last of the undeciphered writing systems of the Bronze Age Civilization of the old world.

ushered in the Indus Script decipherment process with the simultaneous and independent decipherment attempts initiated by a Finnish and a Russian team in the 1960s. After Michael Ventris's success, these were the most elaborate attempts at employing cryptanalytic and scientific methods to systematically attempt to decode any ancient script.[19] I use this archive to demonstrate how the epistemological shift from the epigraphic to the cryptographic occurred in the Indus script decipherment project. Before delving into the specificities of the Finnish and the Russian decipherment attempts of the Indus script, it is important to take a historical detour. Thus, I will first contextualise the importance of the Indus Script decipherment project within the broader imagination of the archaeology of the Indus civilisation.

The Epistemological Place of the Indus Script

The enigma of the Indus civilisation has had a privileged epistemological status in South Asian archaeology.[20] It is closely tied to the meaning of Indian civilisation and the cultural politics of the nation's ancient past.[21] The historical and political importance of the Indus civilisation emerges from its official discovery in the 1920s. This announcement was significantly instrumental in pushing the chronology of the civilisational history of India back by two thousand years.[22] The

It, along with Etruscan, represents an immense challenge to the would-be decipherer. Fame and glory will surely come to those who are credited with cracking the code of the Indus script', in Possehl, *Indus Age: The Writing System* p. 1.

[19] Earlier narratives of the decipherment project like Friedrich, *Extinct Languages*; Dobhofer, *Voices in Stone*; Cottrell, *Reading the Past*; and Pope, *The Story of Decipherment* do mention the Indus script decipherments in varying degree of details. However, it is the most contemporary Robinson, *Lost Languages* that devotes a whole chapter on the Indus script decipherment attempts. However, he fails to recognise the importance of the scientific and cryptanalytic technique in its decipherment since the Finnish and the Russian decipherment.

[20] The Indus civilisation is also known as the Harappan civilization, Indus Valley civilisation, Indus-Saraswati civilisation, Sindhu–Saraswati civilisation—each of these names have potent political and ideological genealogies. I have opted to use the term Indus script, as this is its most popular nomenclature and the earliest name given to the script when it was discovered.

[21] The relationship between archaeology and nationalism is not unique to India. Evidence of this relationship is seen throughout the world from the moment of inception of archaeology as a discipline which could produce knowledge about the past with scientific credibility. For example see: Khol & Fawcett, *Nationalism, Politics, and the Practice of Archaeology*; Díaz-Andreu & Champion, eds., *Nationalism and Archaeology in Europe*; Meskell, ed. *Archaeology under Fire*.

[22] Sir Alexander Cunningham is credited to have discovered the city of Harappa in 1872–73. However the significance of the discovery eluded him. Sir John Marshall in the 'breaking news' article about the Indus Civilization in the *Illustrated London News* in 1924 and underscores the importance of the discovery: 'Up to the present, our knowledge of Indian antiquities has carried us back hardly further than the third century before Christ... now, however, there has unexpectedly been unearthed, in the south of the Panjab and in Sind, an entirely new class of objects which have nothing in common with those previously known to us, and which are unaccompanied by any data that might have helped to establish their age and origin.' John Marshall, 'First Light on a Long Forgotten Civilization,' p. 528.

early Vedic people, categorised as Aryans (dated to c.1800–1500 BC), were considered the original settlers of the subcontinent until the early twentieth century.[23] However, with the discovery of the Indus civilisation, a complete shift in the chronology of ancient India occurred.[24] The sudden appearance of a pristine ancient civilisation on the lines of the other known civilisations of the old world spurred a long and still ongoing process of the rewriting of Indian antiquity.[25] In its early years, the production of knowledge about the Indus civilisation was closely interlinked with the colonial ideology of imperialism and carried with it the subtext of a civilising mission. After independence, the Indus civilisation has been deeply associated with the rise of Indian nationalism.[26]

The discovery of the Indus civilisation initiated a flurry of large–scale excavations in order to solve its mystery.[27] Along with excavation, the Indus Script found on characteristic steatite seals, ceramic, stone and metal artifacts became an important object of inquiry. The Indus Script was always surrounded by an aura of mystery.[28] It was the script of an unknown Bronze Age Civilisation, lost and

[23] The place of the Aryans in the history of ancient India is a politically fraught site of contestation and has seen intensely charged debates. One of the primary reasons for controversies is the lack of robust empirical archaeological and linguistic evidence about the Aryans in South Asia. In recent years this epistemic ambiguity has led to resurgence in Hindutva scholarship challenging the idea of Aryan migration into India and arguing for indigeneity of the Aryans to India. See Erdosy, ed. *The Indo-Aryans of Ancient South Asia*; Bronkhorst & Deshpande, eds., *Aryan and Non-Aryan in South Asia*; Bryant, *The Quest for the Origins of Vedic Culture*; Bryant, & Patton, *The Indo-Aryan Controversy*.

[24] The nineteenth and early twentieth century histories of ancient India were very closely associated with Indo-European Aryans. Colonial Indologists had created a historical narrative which attributed the Aryans the birth of Indian civilization. See Trautman, *Aryans and British India*; Chakrabarti, *Colonial Indology*.

[25] With the discovery of the Indus civilisation, this Aryan–centric narrative was disrupted and nationalist historians invigorated with a discovery of an indigenous Indian civiliation began rewriting the narrative of ancient India within the cultural logic of nationalism. See Ramaswamy, 'Remains of the Race'; Sarkar, *Beyond Nationalist Frames*; Panikkar, 'Outsider as Enemy'; Thapar, 'Politics and the Rewriting of History in India'; Trautmann & Sinopoli, 'In the Beginning There Was the Word'; Bhan, 'Aryanization of the Indus Civilization;' Guha, 'Negotiating Evidence'; Thakran, 'Implications of Partition'.

[26] Chakrabarti, *Archaeology in the Third World*; Chadha, 'Vision of Discipline'; Ramaswamy, 'Remains of the Race'; Guha-Thakurta, 'Monuments and Lost Histories'; Guha-Thakurta, 'The Museumised Relic', Ray, *Colonial Archaeology in South Asia.*

[27] Earliest excavation reports were: Marshall, *Mohenjo-Daro and the Indus Civilization*; Mackay, *Further Excavations at Mohenjo-Daro*; Mackay, *Chanhu-Daro Excavations 1935–36*; Wheeler, 'Harappa 1946: The Defense and Cemetery R37'; Vats, *Excavations at Harappa*; Banerji, *Mohenjodaro: A Forgotten Report*.

[28] Some of the early attempts of decipherments were: Gadd & Smith, 'Sign-List of Early Indus Script'; Heras, 'Light on the Mohenjo-Daro Riddle'; Hunter, *The Script of Harappa and Mohenjo-Daro*; Langdon, 'The Indus Script'; Barton, 'A Comparative List of the Signs in the So-Called Indo-Summerian Seals'.

forgotten. This was a civilisation spread over a large geographic area whose population lived in meticulously planned cities, traded with the known Western world and systematically produced numerous artifacts in urban craft centers. Over the past eighty years, a vast amount of archaeological work has been undertaken in the sub-continent and substantial knowledge about this civilisation has been gathered.[29] Many insightful hypotheses have been proposed regarding its religious, political and cultural systems.[30] In such a context, deciphering the Indus Script was imperative and central to understanding the mystery of the Harappans, especially their religious and socio-political systems. Over the course of many years of scholarship, this script has been transformed into the central metaphor of the enigma surrounding the Indus civilisation.[31]

Many scholars have studied the Indus Script and many have claimed to break its code. However, all have been ultimately declared unsuccessful in deciphering the script, their work relegated to the domain of decipherment attempts.[32] Sharma recorded approximately 2000 standard papers, 101 books and 30 claims of Indus Script decipherment.[33] In this vast production of knowledge spanning the last eight decades, contesting knowledge claims regarding the decipherment have

[29] For the history of the discovery of the Indus civilization see Lahiri, *Finding Forgotten Cities*; Pande, 'History of Research on the Harappan Culture'; Possehl, 'Discovering Ancient India's Earliest Cities'; Singh, *The Discovery of Ancient India*; Ray, *Colonial Archaeology in South Asia*; Possehl, 'Discovering Ancient India's Earliest Cities'.

[30] Some key works on Indus archaeology are: Allchin & Allchin, *The Birth of Indian Civilization;* Allchin & Allchin, *The Rise of Civilization in India and Pakistan*; Kenoyer, *Ancient Cities of the Indus Valley Civilization*; Lal, *The Earliest Civilization of South Asia*; Lal & Gupta, eds., *Frontiers of the Indus Civilization*; Lal, & Mallik, eds., *Indus Civilization: Problems and Issues*; Sankalia, *Prehistory and Proto History of India and Pakistan*; Possehl, *Harappan Civilization: A Contemporary Perspective*; Possehl, *The Indus Civilization: A Contemporary Perspective*; Agarwal, *Indus Civilization: An Interdisciplinary Perspective*; Ratnagar, *Understanding Harappa*; Ratnagar, *Enquiries of the Political Organization of the Harappan Society;* Lahiri, ed., *The decline and fall of the Indus civilization*; Wright, *The Ancient Indus*; McIntosh, *The ancient Indus Valley*; Possehl, *Ancient Cities of the Indus;* Possehl, *Indus Age: The Beginnings*.

[31] A comment by a contemporary archaeologist sums up the challenge of the decipherment. He notes that the Indus Script: 'represents an immense challenge to the would-be decipherer. Fame and glory will surely come to those who are credited with cracking the code of the Indus Script', in Possehl, *Indus Age: The Writing System*, p. 1. The aim of the deciphering the Indus script thus is two-fold. The first is the obvious academic objective; however it is the second that Possehl alludes to in this quote that is the crucial motivating subtext for the decipherer. It is the aspiration to be the first to unveil for the world the mystery behind the enigmatic script. It ensures immortality in the history of both decipherment and Indian archaeology.

[32] Sharma, *Indus on Its Way to Decipherment*; Possehl, *Indus Age: The Writing System*.

[33] Sharma, *Indus on Its Way to Decipherment*, p. 37. Possehl, *Indus Age: The Writing System* provides a synopsis of around thirty-five research attempts at deciphering the script, p. 76. Farmer et al., 'The Collapse of the Indus-Script Thesis' state: 'starting in 1877, over a hundred claimed decipherments have made to the print,' p. 19.

become the norm.[34] Some of these cases have developed into acrimonious public debates.[35] The epistemological landscape of the decipherment project is strewn with numerous theories about the characteristics and content of the Indus Script.[36] These decipherments held various trajectories and shelf-lives. However, each decipherment claimed to be conclusive and scientific and had a subtext of far–reaching personal, political and scholarly desires.[37] Some of them were immediately derided and castigated as examples of bad practice or were regarded as figments of fanciful imagination. Others have surfaced again and again in different configurations. A few decipherments have circulated only in the realm of the amateur and the fringes of academic and scholarly discourse.[38] Claims and counter-claims have been put forth, trenchant critiques and counter-critiques launched. In the process, a cluttered knowledge field has been created.[39] Almost all epistemological claims about the nature of the Indus Script are open to speculation and carry differing degrees of relevance for the scholarly community. Critiques of decipherment have demonstrated that many attempts have been based on cultural and political biases. Or at best, these involve the application of rudimentary linguistic and scientific methods. Although a few decipherments due to their rigorous

[34] For instance, Posshel casting a doubt on the early decipherment sardonically notes: 'There is a lot of intellectual nonsense associated with the attempted undertakings of the Indus script. In some ways much of the early work was so bad that it cast a shadow on the study of the script and it came to be seen as not a reputable undertaking. This has now changed and there are a number of scholars, even whole teams of workers, plugging away at the script'. Possehl, *Indus Age: The Writing System,* p. 81.

[35] For instance, the first decade of the twenty first century has seen numerous acerbic contestations about the Indus script. N. Jha and N.S. Rajaram's explicitly Hindutva decipherment attempt in 2000 is a case in point. This was followed by Farmer et al.'s assertion of Indus script as a non-linguistic symbolic system in 2004 ('The Collapse of the Indus-Script Thesis') and its most recent rebuttal by Rao et al. in 2009a and b. See page 167 for more discussion of this recent controversy and specifically its relationship to cryptographic imagination.

[36] For example, it has been associated with: the Sumerian script, Brahmi, Proto-Elamite, Hittite, esoteric Tantric texts, proto-Dravidian, Indo-European Sanskrit, and with numerical, syllabic, alphabetic, hieroglyphic, logographic, pictographic and ideographic systems. See Sharma, *Indus on Its Way to Decipherment*; Possehl, *Indus Age: The Writing System*; Farmer et al., 'The Collapse of the Indus-Script Thesis'.

[37] Possehl, *Indus Age: The Writing System* poignantly notes: 'it is scarcely a wonder that the writing system [Harrapan script] has not been understood. With everyone reaching directly for The Grail, based on his or her own genius, it seems unlikely that the work [decipherment] could be used in a productive, additive program of research, since it is all so idiosyncratic' p. 168.

[38] For examples of such decipherments see Iravatham Mahadevan, 'Aryan or Dravidian or Neither?'; Possehl, *Indus Age: The Writing System*; Zvelebil, 'Recent Attempts at the Decipherment of the Indus Script'; Sharma, *Indus on Its Way to Decipherment*.

[39] For example Iravatham Mahadevan, in his 1988 Presidential Address in the Indian History Congress, 'What Do We Know about the Indus Script?' notes: 'as no two claims have anything in common, it is hardly surprising that scholars in general have remained skeptical of all attempts,' p. 1.

methodological framework have been at the forefront of academic discourse, none has been able to garner enough support for its particular decipherment.

Colonial Epigraphic Genealogy

The genealogy of the Indus Script decipherment can be traced to Alexander Cunningham in the 1870s, the first Director General of the Archaeological Survey of India. In his numerous surveys in search of Buddhist sites, he visited Harappa and published the first Indus seal in 1875.[40] In this short report on his work at Harappa, he indicated that the inscription on the seal was unfamiliar to him and suggested, 'they are certainly not Indian letters; and as the bull [on the seal] which accompanies them is without hump, I conclude that the seal is foreign to India'.[41] A couple of years later, in his monumental work on Ashokan inscriptions (272–32 BCE), Cunningham provided a contrasting premise. He compared the inscription found in Harappa to the contemporaneous Egyptian and Mesopotamian civilisation. He also indicated that the script had close affinity to the Brahmi of the third century BC, and read the word *Lachhmiva* in 'archaic Indian letters of as early an age as Buddha himself'.[42] These elementary efforts by Cunningham are in no way representative of the later knowledge production process of scholars working on Indian archaeology, but they undoubtedly form the prologue to the state of inquiry in following years.

The lineage of Cunningham and the colonial Indological project can be traced back to the comparative philological project in colonial India pioneered by William Jones, the founder of the Asiatic Society of Bengal in 1784, and his successors. His identification of the linguistic resemblance between Sanskrit, ancient Iranian and European languages such as Greek and Latin, laid the groundwork for inquiry in Indo–European languages.[43] His intention was to situate the knowledge about India, its people, society, culture, history, language and religion in the framework of the unitary origin of man in a pre evolutionary Biblical chronology.[44] However, his work had profound consequences on the constitution of incipient Indological

[40] Alexander Cunningham, *Report for the Year 1871–72*. This discovery is considered to be the earliest moment in the history of Indus archaeology. See Pande, 'History of Research on the Harappan Culture'; Possehl, 'Discovering Ancient India's Earliest Cities'; Singh, *The Discovery of Ancient India:* pp. 97–98. Lahiri, *Finding Forgotten Cities*, pp. 22–26.

[41] Alexander Cunningham, *Report for the Year 1871–72, Archaeological Survey of India Report*, p. 108.

[42] Alexander Cunningham, *Inscription of Asoka. Corpus Inscriptionum Indicarium*, p. 61.

[43] William Jones, 'The Third Anniversary Discourse'; On the impact of William Jones on the history of Indology see: Chakrabarti, *A History of Indian Archaeology*; Paddayya, 'Theoretical Perspectives in Indian Archaeology'; Murray, ed. *Sir William Jones 1746–94*; Mukerjee, *Sir William Jones*; Kejariwal, *The Asiatic Society of Bengal*; Trautman, *Aryans and British India*.

[44] Paddayya, 'Theoretical Perspectives in Indian Archaeology' p. 119; Chakrabarti, *A History of Indian Archaeology*, p. 33.

scholarship whose ideological reverberation continues till today.[45] Of Cunningham's many predecessors, it was the work of James Princep whose lineage can be directly traced to colonial epigraphy.[46] Princep was one of the many nineteenth century scholars keenly interested in deciphering ancient Indian scripts found inscribed on innumerable monuments, coins, stones and metal artifacts throughout South Asia.[47] In 1838, he published a number of papers deciphering the ancient Brahmi script used in Ashokan inscriptions.[48] Although Princep's decipherment was not entirely the work of an individual genius, his contribution to the nineteenth century Indology had a lasting effect.[49] Other than establishing the basic framework for the scholarship in studies of ancient India, in particular that of epigraphy, he was also responsible for influencing Alexander Cunningham, who was Princep's associate at the beginning of his career. [50]

The decipherments of the Finnish and Soviet teams caught the eye of the community of South Asian archaeologists and Indologists not only because they were the most scientific decipherments of the script, but also because they both intriguingly concluded that Indus Script signified a Proto–Dravidian language. This premise was not new. John Marshall had proposed a theory of the Dravidian origin of the script in 1931.[51] Soon after the discovery of the Indus script, Piero Meriggi, who was working on the Hittite script, had made an unsuccessful attempt to connect the Indus script with the contemporary Dravidian language—the Brahui of Baluchistan.[52] The first serious effort of pursuing the Dravidian hypothesis was made by Fr. Henry Heras, a Spanish Jesuit missionary and Indologist teaching at

[45] Chakrabarti, *Colonial Indology*; Trautmann, & Sinopoli, 'In the Beginning There Was the Word'.

[46] For a genealogy of colonial epigraphy see, Dirks, 'Colonial Histories and Native Informants'; Wagoner 'Precolonial Intellectuals.'

[47] Nair, *James Prinsep: Life and Work*; Kejariwal, *The Asiatic Society of Bengal*.

[48] Prinsep published number of articles between 1834–38 that deciphered the Ashokan edicts, which has been discovered throughout the Indian subcontinent at a regular pace around this time. Of his most important articles in which he very clearly able to read the Ashokan Brahmi are: Princep, 'On the edicts of Piyadasi or Asoka' and 'Examination of the inscription from Girnar'.

[49] Chakrabarti, *A History of Indian Archaeology*, p. 34.

[50] See Imam, *Sir Alexander Cunningham and the Beginnings of Indian Archaeology*; Kejariwal, *The Asiatic Society of Bengal*.

[51] John Marshall provided three justifications: 'because the Dravidic-speaking people were the precursors of the Aryans over most of Northern India and were the only people likely to have been in possession of a culture as advanced as the Indus culture; secondly, because on the other side of the Kirthar Range and at no great distance from the Indus, the Brahuis of Baluchistan have preserved among themselves an island of Dravidic speech which may well be a relic from pre-Aryan times, when Dravidic was perhaps the common language of these parts; thirdly, because Dravidic languages have been agglutinative, it is not unreasonable to look for a possible connection between them and the agglutinative language of the Sumer in the Indus' in Marshall, *Mohenjo-Daro and the Indus Civilization*, p. 42. For the latest Proto-Dravidian origin theory of the Indus Script, see Wells, *An Introduction to Indus Writing*.

[52] Meriggi, 'Zur Indus-Schrift'; Meriggi, 'Uber Weitere Indussiegel Aus Vorderasian'. Also see Zide, 'A Brief Survey of Work to Date on the Indus Script', pp. 5–6.

Bombay University. He reconstructed the Proto–Dravidian script on the basis of comparison between the Indus script and the scripts of daughter languages. He argued that the script was a picto–phonographic one.[53] Heras claimed that the signs did not stand for syllables or consonants but for distinct words: 'the language spoken by the Mohenjo-Darians was not any of the modern Dravidian languages, but an older language, perhaps the parent of these languages, which may be styled Proto–Dravidian'.[54] This decipherment, though rejected by most, had a longstanding impact. However, several years later, Heras's work was picked up by both the Soviet and the Finnish teams.[55] It is within this historical context that the decipherment attempts of the Finnish and the Soviet groups gain importance. Not surprisingly, their work was regarded as the most academically legitimate within the community of archaeologists, Indologists and South Asian scholars.

Cryptographic Imagination in Finnish and Soviet Scientific Decipherments

It is with the decipherment attempts of the Finnish and Russian teams in the late 1960s and the early 1970s that the distinct cryptographic imagination permeated into the field of the Indus script decipherment project. Both teams began their decipherments independently in 1964 with a cryptological optimism that in theory it was possible to decode the Indus script. The genealogy of the decipherment process demonstrates that it was already a very cluttered field with considerable political and historical valence at stake. Into this epistemic field, the Finnish and the Russian teams brought in a distinct cryptanalytical framework to break the code of the Indus script, distinct from earlier epigraphical interventions. Epitomised by the overt employment of the systematic application of the scientific approach, newly introduced usages of computers, mathematical, statistical algorithms formulated the practice of cracking the ancient code. This practice, as I will demonstrate, was both an articulation of the methodological incisiveness of the military cryptographer and the technological ingenuity of a scientific scholarship. Their decipherment brought in an optimistic possibility into the field of Indus script decipherment and transformed it fundamentally, epistemologically shifting it from the domain of epigraphic interventions to cryptographic.

[53] Heras, 'Light on the Mohenjo-Daro Riddle' p. 7; Heras, *Studies in Proto-Indo-Mediterranean Culture,* p. 65.

[54] Heras, *Studies in Proto-Indo-Mediterranean Culture*, pp. 64–65.

[55] Commenting on the influence of Heras's work, Zvelebil notes: 'It is only fair to say that even the very recent attempts to decipher the scripts do not go very much beyond what Heras has achieved intuitively. It is quite apparent that these contemporary attempts [Soviet and Finnish] have drawn much inspiration from Heras, both as to the method of segmentation of the signs, and to the interpretation of their function and meaning'; in Zvelebil, 'Recent Attempts at the Decipherment of the Indus Script' p. 156. Also see Joseph, 'Harappa Script Decipherment: Rev. Heras and His Successors'; Possehl *Indus Age: The Writing System*, p. 115.

Yuri Knorozov, a professional decipherment expert who was simultaneously working on deciphering the Mayan script,[56] led the Soviet team consisting of a Dravidian linguist, ethnologists and a mathematician.[57] Asko Parpola, an Indologist and comparative philologist, along with an Assyriologist, computational linguist and a computer scientist, led the Finnish team.[58] The idea of a team of experts working together to decipher the Indus Script was a pioneering strategy. For the first time, the Indus script decipherment project was not dependent on the work of some individual genius, but was articulated as a collaborative project of a group of scholars who attempted to legitimise their decipherment on the basis of professional experience and expertise.[59] The effort unambiguously demonstrated that the task of Indus script decipherment was a complex scientific enterprise. It necessitated expert knowledge of multiple disciplines and scientists strategically positioned within a 'cycle of credibility'.[60] The decipherment project demanded various professionals, each working on separate components of the project as a collaborative endeavor:

> We decided to divide the work so that Simo Parpola, as a specialist in the Near Eastern Scripts, would take up the elaboration of the material for comparison, Seppo Koskenniemi, the computer work, and Asko Parpola the analysis of the Indus script.[61]

[56] For a heroic account of the role of Knorozov in decipherment of the Mayan hieroglyphs see Coe, *Breaking the Maya Code* Also see Coe, 'A Triumph of Spirit'. For works in english by Knorozov on Mayan hieroglyphs, see Knorozov, *Maya hieroglyphic codices.*

[57] Key Soviet decipherment texts available in English translations were: Field & Edith Larid, eds, *Soviet Studies on Harappan Script*; Field, ed., *Proto-Indica*; Gurov & Knorozov, *Proto-Indica*; Zide & Zvelebil, eds, *The Soviet Decipherment of the Indus Valley Script*.

[58] Key Finnish decipherment texts were: Koskenniemi, 'Syntactic Methods in the Study of the Indus Script'; Koskenniemi & Parpola, *Corpus of Texts in the Indus Script*; Koskenniemi & Parpola, *A Concordance to the Texts in the Indus Script*; Koskenniemi, Parpola & Parpola, *Materials for the Study of the Indus Script*; Koskenniemi, Parpola & Parpola, 'A Method to Classify Characters of Unknown Ancient Scripts'; Parpola, 'The Indus Script Decipherment: The Situation at the End of 1969'; Parpola, 'Computer Technique in the Study of the Indus Script'; Parpola, 'Task, Methods and Results in the Study of the Indus Script'; Parpola, 'The Indus Script a Challenging Puzzle'; Parpola, 'The Size and Quantity of the Indus Seals'; Parpola, *Deciphering Indus Script*; Parpola, Koskenniemi, Parpola & Alto, *Decipherment of the Proto-Dravidain Inscription*; Parpola, Koskenniemi, Parpola & Alto, *Progress in the Decipherment*; Parpola, Koskenniemi, Parpola & Alto, *Further Progress in the Decipherment*.

[59] Contemporary science is viewed by historian of science as a collaborative project of numerous experts, rather than a product of individual genius. This is considered as an important shift from the nineteenth and early twentieth century practice of scientific knowledge production. See Collins & Evans, 'The Third Wave of Science Studies.'

[60] Latour & Woolgar, *Laboratory Life*, p. 198; Also see: Shapin, *A Social History of Truth*; Gieryn, *Cultural Boundaries of Science: Credibility on the Line*.

[61] Parpola, Koskenniemi, Parpola & Alto, *Decipherment of the Proto-Dravidain Inscription*.

The approach was to invoke the epistemic influence of multiple disciplinarian practices to simultaneously gain scholarly integrity and underscore team's authority within the fractured community of Indus script deciphers. Both the teams produced texts that displayed the multi-disciplinarian authority of their decipherment by having chapters by various individual authors as in the case of the Soviets or articles by various authors in the case of the Finnish team. This scholarly performance of expertise and experience by both the Soviet and Finnish teams was motivated by a felt need to instill in the sub discipline of Indus Script decipherment a strong scientific and a rigorous methodological basis. This thrust was propelled by the need to push the disciplinarian boundaries of Indus Script decipherment project away from the confines of the non-scientific decipherers theoretically aligned with the dominant culture–history (therefore epigraphically aligned) paradigm of archaeology. The aim was to bring the project of Indus script decipherment into the forefront of scientific archaeology. This strategy had the desired impact on latter decipherments of Indus script. Some of the most significant decipherments that have claimed to be scientific in subsequent years were undertaken as collaborative project with a team of professionals with expertise in various disciplines.[62]

By using the scientific method, the Soviet and the Finnish teams put forward a technique that was not only positivist in its approach but also employed distinct cryptographic technological tools that had not been applied in previous Indus Script decipherments. It was a strategic attempt to introduce methods ostensibly perceived as scientific and authoritative (cryptographic) into a disciplinary formation that was essentially located in the domain of humanities (epigraphic). The effort was to simultaneously assert their epistemological authority while performing the role of disciplinary reformers. The scientific method was the discursive ideology through which the Finnish and the Russian teams articulated their cryptographic intervention. Not surprisingly, the teams framed their research within the larger matrix of positivist theory and Popperian falsifiability:

> [I]t is necessary to keep on trying to find a solution. To be convincing, it must agree with generally accepted knowledge and the methods by which such a solution has been reached must be scientific and open to scrutiny. Reduced to

[62] For instance see Mahadevan, & Visvanathan, 'Computer Concordance of Proto-Indian Signs; Farmer et al., 'The Collapse of the Indus-Script Thesis' and the most recent Rao et al., 'Entropic Evidence' which consisted of half a dozen of authors from institution spanning two continents. However, the trend of the single decipherer did not discontinue—among the most prominent were a former Archaeological Survey of India archaeologist who had led the influential excavation of the Indus site at Lothal—Dr. S.R. Rao in 1982, and the American archaeologist Walter Fairservis, the excavator of Harappa in 1992. Rao argued that the Indus script was a precursor to the Ashokan Brahmi. Rao, *The Decipherment of the Indus Script*; whereas Fariservis attempted to show that the script was proto-Dravidan; Fairservis, *The Harappan Civilization and Its Writing*.

> its barest essence, the scientific method of solving a problem consists of two operations: (1) devising theoretically justifiable hypotheses and (2) testing them.[63]

This passage is significant as it underscores the ideological impetus of the decipherment project for both the Finnish and the Soviets. It explicitly articulates the need to study the Indus Script as a scientific puzzle and not as an incomprehensible inscription. It envisages Indus script as a problem that can only be successfully solved by employing scientifically driven hypothetico-deductive method. Parpola contextualised the problem within a discourse of objectivity, where the underlying belief was that if the decipherment was conducted in a cryptographic manner, it was bound to produce correct results:

> The problem of the Indus script is like a crossword puzzle. As long as there is no bilingual, we cannot be absolutely sure whether the script or the sign belonging to it has been deciphered correctly, just as a solution to a puzzle or an individual clue will remain a matter of probability until it can be verified by the official published version...only very experienced puzzle–solvers will arrive at the correct solutions right away.[64]

With this strategy of performing cryptographic authority, decipherers were tactically placed to forcefully argue for a scientific decipherment of the Indus Script. They structured their research not only as an innovative decipherment but emphasised that their methodological framework was robust and programmed to produce objective results. The implication for the advocacy of this technique was to propose that earlier decipherments had failed because they were methodologically flawed research designs, and were not scientific or rigorous enough in their conceptual approach. It is not a coincidence that this call for scientific decipherment by both the Soviet and Finnish team also coincides with the rise of processual archaeology.

Historically, by the end of the nineteenth century, archaeology, like most social sciences, viewed itself as a science in terms of the empirical knowledge that it created.[65] It was only in the early 1960s that a concerted attempt was made to refurbish its objective authority—archaeology was then determined to be closer to

[63] Parpola, *Deciphering Indus Script*, p. 3.

[64] *Ibid.,* p. 273.

[65] See Daniel, *A Hundred Years of Archaeology*; Daniel, *A Hundred and Fifty Years of Archaeology*; Trigger, *A History of Archaeological Thought*; Kehoe, *The Land of Prehistory*; Schnapp, *The Discovery of the Past: The Origins of Archaeology*.

the subjective practices of historical and cultural approaches. Influenced by anthropology's assertion of an objective claim to knowledge,[66] archaeology, in the avatar of 'processual archaeology,' saw itself shedding its culture–history model of knowledge construction in favor of robust analytical empiricism.[67] The culture–history model, originating in the late nineteenth century, had gained its scientific legitimacy by employing the received wisdom of the geological sciences, the systematic process of excavation and the usage of typological and classificatory diagnostic frameworks.[68] On the other hand, its successor—processual archaeology—predisposed by cultural–evolution theories of predictable changes, attempted to reinforce archaeology's objective claim to the past by the rigorous application of scientific method, the creation of data through observation, experimentation and the employment of hypothetico–deductive reasoning. This gave rise to the environmental deterministic view of the past, lacking in human agency, and de-legitimising cultural categories. It was accompanied by an overt proclamation of objectivity based solely on a rigorous application of scientific method. Christianised as 'New Archaeology,' it propelled an objective view of the past, and had a widespread methodological impact throughout the world of archaeology. Although a close scrutiny of the references of the Soviet and Finnish texts does not explicitly show that they were conversant with the theoretical advances of processual archaeology, however it would not be an exaggeration to say that their work was informed by the same theoretical and methodological influences which were operating on archaeology in the 1960s–70s.

The introduction of computers made the project of the Soviet and Finnish teams technologically superior to earlier decipherment attempts. The importance of computers was often stressed throughout the various texts on decipherment. In the first announcement of the decipherment text Parpola mentions:

> In September, 1964, when discussing the possibilities of using computers in linguistics with my old friend Seppo Koskenniemi, I suggested that we should try to decipher the Indus script with the help of a computer, after having learnt that IBM would be willing to give us necessary facilities.[69]

[66] Lyman and O'Brien, 'Cultural Transmission'.

[67] Binford, 'Archaeology as Anthropology'; Binford, 'Archaeological Systematics and the Study of Culture Process'; Binford & Quimby, *An Archaeological Perspective*, p. 464; Clarke, *Analytical Archaeology*, p. 684; Salmon, 'What Can Systems Theory Do for Archaeology?'; Schiffer, *Formation Processes of the Archaeological Record*, p. 428; Schiffer 'The Structure of Archaeological Theory'; Watson, LeBlanc, & Redman, *Explanation in Archeology*, p. 191.

[68] See Dunnell, 'Style and Function'; Lyman & O'Brien, 'Cultural Traits'; Lyman, O'Brien, & Dunnell, *The Rise and Fall of Culture History*, p. 271.

[69] Parpola, Koskenniemi, Parpola, & Alto, *Decipherment of the Proto-Dravidain Inscription*, p. 47.

In the case of the Soviet decipherment, it was fairly clear that the uniqueness of the decipherment attempt was the extensive usage of computers.[70] Zide & Zvelebil point this out:

> The unevenness of the monographs, the frequent overassertiveness and lack of rigor and documentation constitute some of the major flaws in the monographs but do not eliminate their significance as the first attempt to employ computer techniques and statistical methods (however limited) to Proto-Indian inscriptions.[71]

If the hypothetico–deductive method was the *conceptual apparatus* in solving the mystery of the Indus Script, then computers became the *technological apparatus* to produce the solution. That this technological marvel could transform the decipherment project and its application, contributed to the belief in the success of the project:

> ...the computer is a faithful servant of man, which, in carrying through quickly and efficiently his orders, can save him a lot of time and trouble. Especially when extensive mechanical work is concerned, its help, if not indispensable, is instrumental in sparing man the frustration and mental fatigue resulting from lengthy and tiresome labor. One can concentrate on theoretical problems and leave the practical realisation of ideas to machine...the computer can quickly perform complicated mechanical operations that would take ages to do by hand, and it thus opens up possibilities of study that have never before been at the disposal of scholars'.[72]

It was the deployment of computers alongside the theoretical legitimacy of science, which epitomised the authoritative mechanism of the cryptanalytical method that made both decipherments influential. The researchers wanted to turn the decipherment into a scientific endeavor and rescue the study on Indus Script decipherment from the quagmire of subjective historical, philological and Indological scholarship. Underlying their project was the subtext of transforming the study of Indus Script decipherment into a rigorous activity, which was only possible through the application of the cryptographic imagination.

Any script in order to be decoded has to be first ascertained, interrogated, its signs and structure unveiled and an assembly of its signification system compiled

[70] Field & Larid, eds, *Soviet Studies on Harappan Script*, p. ii.

[71] Zide & Zvelebil, eds, *The Soviet Decipherment of the Indus Valley Script: Transaltion and Critique*, p. 6.

[72] Parpola, 'Computer Technique in the Study of the Indus Script,' pp. 10–11.

and catalogued. The coding mechanism had to be differentiated, segregated, divided into units and homogenised into a corpus that contains all the variability, differences, anomalies, similarities and idiosyncrasies. The corpus thus becomes the inception point of any decipherment project. It is an attempt to discipline the landscape of dispersed signs and is brought together as seemingly whole, providing a regulated, complied and standardised version of the Indus script.[73] An all encompassing compilation of the Indus script found its ultimate realisation with the belated publication of the two volumes *Corpus of Indus Script and Inscription* between 1987–91, planned as a companion to the archaeologist/decipher, which is a compilation of more than three and a half thousand inscriptions found on various kinds of artifacts, from seals to ceramic fragments.[74] A project initiated by Asko Parpola, it was argued to be the most important process of the decipherment process as:

> ...the texts in standardised editions and concordances are based upon the subjective judgments of individual scholars, and they do not display all the intricacies of the originals. Moreover, they contain numerous admittedly doubtful readings. Objective photographs of the original inscriptions thus are a necessary complement to such textual studies.[75]

The photographs of the inscriptions were classified by complex sets of ten 'criteria'. These criteria, explained in scientific rhetoric emphasised the objective of the photographic record:

> ...the texts in standardised editions and concordances are based upon the subjective judgments of individual scholars, and they do not display all the intricacies of the originals. Moreover, they contain numerous admittedly doubtful readings. Objective photographs of the original inscriptions, thus are a necessary complement to such textual studies.[76]

The compilation project was driven by the need to produce a scientific and photographic assemblage of the Indus script as an aid for decipherment. Their

[73] Parpola emphatically asserts: 'first is the collection of material into a corpus. Comprehensiveness must be the aim, because the extent and diversity of the available material affect the chances of a solution. What looks possible from an inspection of a small amount of data may be disqualified by the discovery of a new material. A single text might contain a crucial clue'. Parpola, *Deciphering Indus Script*, p. 61.

[74] The first volume edited by Parpola and Archaeological Survey of India's J.P. Joshi consisted of photographs artifacts of inspiration in India; the second volume edited by Parpola and S.G. Shah consisted of the Pakistan collection.

[75] Joshi & Parpola, *Corpus of Indus Seals and Inscription*, p. xxi.

[76] *Ibid*.

conceptual impetus was determined by cryptographic considerations of disciplining the data and controlling it in theoretical matrices.

The constitutive modalities of the scientific method consisted of grasping the undecipherable terrain of the script into a grided mathematical universe. This was undertaken in order to isolate the unknown system into a comprehensible formation. This constituted the fragmentation of the script signs into a concordance grid and examining the various patterns through the application of statistical analysis. Both teams underscored the importance of statistical analysis as the systematic technique in deciphering an unknown script. On the lines of the successful decipherment of Linear B, a concordance was considered to the key of correct decipherment when a bilingual script is unavailable. Earlier Indus Script decipherment attempts had essentially applied typical culture–history methods of epigraphic comparison. This approach involved creating a classificatory index of various Indus Script signs and then comparing it with other known scripts like Sumerian or Brahmi in order to demonstrate its relation to the Indus Script. This method gave birth to the conceptual grid with a cartographic framework—the concordance. Although concordance was a medieval strategy of isolating words in the Bible to show their context, in the hands of decipherers it became a tool by which the frequency of unknown symbols could be mapped.

The efficacious application of the concordance devised by Alice Kober and Michael Ventris to grid the multiple alphabets of the Linear B had made the technique an essential tool for the decipherment of any ancient script.[77] G.R. Hunter in 1934 is credited to have assembled the earliest concordance for the Indus Script.[78] The concordance was a linear grid to determine the underlying pattern of the various signs of an unknown signification system by mapping the symbols. The purpose of the concordance was to discover the features of a particular sign. It involved disentangling an individual sign in an inscription, in order to locate its significance. This importance of a single sign gives birth to the concordance. The concordance was a gridded network that was created in order to profile the behavior of each sign. The cartographic map facilitated the tracking of each individual

[77] Although grid and concordances were used in the decipherment of the Mesopotamian cuneiform and other decipherment, it transformed into an essential scientific apparatus of decipherment with its successful application by Kober and Ventris in the decipherment of Linear B. See Ventris & Chadwick, eds, *Documents in Mycenaean Greek*, pp. 14–20; Chadwick, *The Decipherment of Linear B*, pp. 40–66.

[78] Consisting of 800 inscriptions, Hunter organised the various signs in grids and tables to locate relationship, variations and delineate their formal characteristics, in order to profile the behaviour of each sign, track its syntactic performance and to probe their positional relation to other signs within and without an inscription. Hunter, *The Script of Harappa and Mohenjo-Daro*. However a rudimentary sign list was also complied by Gadd & Smith in Marshall's Mohenjo-Daro Report. See Gadd & Smith 'Sign-List Of Early Indus Script'.

sign, its syntactic performance and probed its positional relation to other signs within and without an inscription.[79] The central purpose of the concordance was to map each sign of the unknown script and locate the meaningful relationships between various signs and the total corpus of the Indus Script. Such collation enabled the teams to apprehend the terrain of the script and systematise the varied signs by arranging them into manageable units for decipherment. This mapping of the signs was then followed by a statistical analysis of the data and by running it through mathematical algorithms:

> Beside a concordance of each sign, it is useful to generate various kinds of statistics—frequencies of individual signs and signs combination (grand total and totals in different positions within the inscription), of texts with different lengths, of object types, of iconographic motifs etc.—and to tabulate the distributions of signs and other variables in relation to different criteria.[80]

It was simultaneous mapping of the disparate landscape of the sign elements of the unknown script into a gridded universe along with the application of statistical and mathematical formulation to produce comprehensible patterns that signified the cryptographic imagination of the decipherer.[81]

Once the concordance enabled the decipherers to visually and conceptually grasp the varying relational characteristics of the individual syllable, then statistical and mathematical algorithms were run through the data to test the validity of the relations. This mapping was then followed by interpretation of the data set to devise penetrating insights about the hidden patterns of the signs. For example, the Soviet team proposed that the script was neither syllabic nor alphabetic, but logo–syllabic in nature. Knorozov utilised the rebus method of correlating graphic signs with acoustic signs of the language and argued that the language of the script belonged to the Dravidian family. He applied interval statistics to divide the Indus texts into two blocks corresponding to word–forms and word–combinations in order to locate semi-variable (block forming) and variable (block altering) signs:[82]

[79] For the relationship between concordance and gird analysis see Parpola, *Deciphering Indus Script*, p. 89.

[80] *Ibid.*, p. 64.

[81] Almost simultaneously Iravatham Mahadevan along with K. Visvanathan published a computer–generated concordance in 1973 (using IBM 1620 computer). This eventually was instrumental in the making of the most comprehensive computer–generated Indus script concordance by Mahadevan (using Control Data Corporation's CDC 3000 series computer, at Tata Institute of Fundamental Research, Bombay). The corpus consisted of '2906 texts in 3573 lines with 13372 legible sign occurrence' was assembled using the Archaeological Survey India's photographic card catalogue, and included inscriptions recently excavated from Lothal (1954–63) and Kalibangan (1960–69). See Mahadevan, 'Computer concordance of Proto-Indian signs', p. 19.

[82] Knorozov, 'The Characteristics of the Language of the Proto-Indian Inscriptions,' p. 57.

> to identify sign groups corresponding to the linguistic units the Proto–Indian texts (converted into a digital code) were automatically processed, and all sign groups occurring two or more times (intersections in mathematical terms) were thus registered. At the same time the program registered recurrent sign combinations separated by other signs within the whole inscriptions [interval statistics].[83]

The words thus deciphered were located in the *Dravidian Etymological Dictionary*, and then ascribed a 'value'. Furthermore, the focus of M.A. Probst, the Soviet team's mathematician, was to unearth the structure of the text, so that the grammatical markers of the language could be revealed, and to determine its linguistic affiliation to draw phonetic and semantic comparisons with known languages. His method was based on a computing approach called 'machine methods,' which used computer programmes to determine the type of script and to analyse the construction of texts. The process involved the creation of a digital transcription of the Indus Script. Each sign was substituted by a numerical value and the data was fed into a computer programme driven by a mathematical algorithm to produce a 'description of the construction of the text'.[84]

A.M. Kondratov of the Russian team, on the other hand, argued for 'positional–statistical' methods in order to reveal the hieroglyphic character of the Indus Script. He emphasised that such a positional–statistical analysis was possible only through the usage of computer technique and involved:

> 1. determining the system of the script; 2. discovering the preliminary referents of the signs; 3. dividing the texts into blocks; 4. distinguishing variables and semi-variable signs and determining different classes of root-signs; 5. determining the combination into which the variable enter.[85]

He applied the positional–statistical analysis to the 6,300 signs of Indus Script and compared it with an unsegmented fragment of 1,650 ancient Egyptian hieroglyphic signs. His intention was to investigate the artificial polygrams occurring during the process at the junctures between inscriptions in order to discover analogous combinations within inscriptions. The result showed that the curve of emergence of new signs in relation to the growth of the length of a text in the proto–Indian inscription coincided with the curve of the emergence of new signs in ancient Egyptian. Thus, Kondratov argued that the Indus Script was a script that had hieroglyphic characteristics, and that the language contained of suffixation

[83] Knorozov, 'The Formal Ananlysis of the Proto-Indian Texts,' p. 100.
[84] Probst. 'Machine Methods of Investigation', p. 26.
[85] Kondratov, 'The Positional–Statistical Analysis', p. 39.

and combination of two final variables. Although the Soviet decipherment project received favourable reviews as far as formal analysis was concerned, the criticism leveled at them was similar to that raised against earlier decipherment attempts.[86]

The approach of the Finnish team was also based on statistical frequency and mathematical positional analysis of each grapheme unit in order to differentiate between individual signs, ligatures and signs that are end markers. The procedure adopted was to transform all the available signs into machine–readable data:

> ...drawing up a sign-list, allotting to each sign a three-digit number, and transcribing the inscriptions into numerical form. Each inscription (the average length being only five signs) was then punched on a separate IBM card, headed by a source reference in the form of a four-digit number.[87]

Parpola and his team members organised the corpus of the Indus Script according to a number of categories, creating a taxonomy intended as a coherent system of thought:[88]

> 1. how many signs there are *altogether* in the Indus inscriptions that are available for study, and what is the *average* length of an inscription; 2. how many *different* signs are there; 3. what is the *frequency of occurrence* of each individual sign; 4. what is the *order of frequency* of the signs; 5. how many times within its total frequency each sign occurs in *initial* and *final* positions in the inscriptions; 6. which other signs occur on the left-hand side, and which signs on the right-hand side of each individual sign; and what are the total, initial, and final frequencies of these *pair wise occurrences* and what is their order of appearance;

[86] Zide & Zvelebil in their analysis of the Soviet crtically note: 'The primary defect in Knorozov's paper (and Gurov's paper as well) is the speculative and intuitive manner in which he attempts to equate typological structure found with Dravidian typological structure—i.e., *the manner in which they supply concrete readings*. Various equations are made but no concrete internal system emerges, the inner workings of the script are not demonstrated. In fact no system emerges which shows a Dravidian solutions to inconvertible' Zide & Zvelebil, eds, *The Soviet Decipherment of the Indus Valley Script*, p. 112. Also see Zvelebil, 'Recent Attempts at the Decipherment of the Indus Script,' p. 158.

[87] Parpola, 'Computer Technique in the Study of the Indus Script,' pp. 11–12.

[88] The signs were divided into nine tables, which indicated the frequency and the positional distribution of the signs. These tables were: 'the frequency of the pairwise sign combination; and various distribution [signs by object types; signs by iconographical motifs; direction of writings first by site, then by object types; iconographical motifs first by sites, then by object types]' (p. 13). The concordance was created using the Burroughs B6700 computer and a CalComp 1039 plotter, the processing was done mainly with an Extended Agol programme package for linguistic data processing, called LINUS and written by Koskenniemi.

7. in the *list of all occurrences* of all pairwise sign combinations, the full context and all relevant information about each inscription [type, provenance and iconography of object on which the inscription is found, number of lines, and so forth].[89]

This effort had an unambiguous statistical subtext, guided by an assumption that the corpus of signifiers followed a pattern with meaningful categories that could be organised into a systematic lexicon useful in deciphering the structure of the pattern. Their supposition was based on the idea that: 'writing is subject to measurable laws governing speech and dictated by human physiology, which make only certain sound combinations possible. Therefore it should be possible to develop an automatic method of decipherment based on statistical data only, which would have universal validity.'[90] This led the Finnish decipherment team to believe that the Indus Script was a logo–syllabic writing system and their main thrust of decipherment was to create a 'formal grammar of the corpus that indicates the paradigmatic and the syntagmatic relations of the signs and signs sequence'. [91]

The Finnish proposal also presented a mathematical algorithm that could meticulously classify the 'characters of an unknown ancient script' by developing a 'method of analysis which would yield the same reasonable result when applied to any sample of known script and hence also when applied to an unknown script.'[92] This algorithm was applied to five ancient scripts, each with around 8,000–10,000 signs—Elamite cuneiform, Linear B, Neo-Assyrian cuneiform, Middle Egyptian Hieroglypis and Sumerian Cuneiform. The algorithm was partially successful in deciphering these known scripts and on the basis of this success they claimed that the application of the algorithm to an unknown script such as the Indus Script would yield reasonably accurate results. The mere usage of the mathematical and statistical formulae in deciphering the Indus script was epistemologically powerful. The confidence of such mathematical imagination was so potent that the paper in which the Finnish team proposed the above mathematical algorithm ended with a postscript, which suggested that they had been successful: 'This paper was completed in October 1968. The code of the Indus script was broken in January 1969'.[93] In fact, the paper only proposed the algorithm and did not provide any conclusion about its reality when applied to the Indus script.

Although the Finnish and the Soviet teams, in their narratives of decipherment consistently presented their insights as products of a hypothetico–deductive process, they seemed to be dependent on reasoning to decipher Indus Script, which

[89] Parpola, 'Computer Technique in the Study of the Indus Script,' p. 11.

[90] *Ibid*., pp. 14–15.

[91] Parpola, *Deciphering Indus Script*, p. 101.

[92] Koskenniemi, Parpola & Parpola, 'A Method to Classify Characters of Unknown Ancient Scripts,' p. 66.

[93] *Ibid*., p. 91.

could at best be described as abduction.[94] For the teams, the epistemological location of the Indus Script was transformed into a mystery in which abduction was used to propose a hypothesis and evidence in its favour was accumulated. This can be seen especially in the way that meaning is assigned to individual symbols. For example, in the first announcement of the Finnish decipherment it is stated:

> My brother suggested that the sign [comb] denotes feminine because it behaves exactly like [human figure] which must denote masculine. This I realised at once to be the correct interpretation. Quite independently Pentti Alto suggested that the sign [water carrier] was the plural suffix. 'because to bear begins with k in Dravidian'....[B]ut the discovery that the best word for 'woman/feminine' was phonetically identical with the best word for 'comb' in Dravidian, convinced me that decipherment had began. From that moment I realised that the script must be logographic, because the words were polysyllabic.[95]

Knorozov of the Soviet team described an equally abductive technique of assigning meaning to Indus Script symbols:

> For example, sign 96, depicting the hand usually occurring after alternating numerals, obviously corresponds to the Sanskrit *prasrti*, 'handful' (the basic unit of liquid measure). In that case the imprint on the vessel (made after firing) IV-96 signifies '4 handfuls', which corresponds to approximately a half liter in traditional Indian system of measurements.[96]

Here, the expert decipherer was one who was not only able to apprehend the script in his cryptographic imagination, but also to produce useful guesswork that resolved the abstract landscape of an unknown script. Parpola underlined the abductive subtext of the decipherment project when he argued:

[94] Here I am specifically invoking Charles Pierce's idea of abduction which he defines as 'the process of forming an explanatory hypothesis. It is the only logical operation that introduces any new idea; for induction does nothing but determine a value, and deduction merely involves the necessary consequences of pure hypothesis' [Hartshone & Weiss, *Collected Papers of Charles Sanders Peirce: Pragmatism and Pragmaticism*. 5.171]. Abduction is the step between the known fact and its origin, a perceptual leap—a process by which informed hunches are produced about the world. It allows a scientist/detective/decipherer to make a conjecture, which can be tested out to prove or disprove the hypothesis. Bauer explicitly uses the theoretical framework developed by Charles Peirce to understand how meaning of an artifact in archaeology is produced specifically in museum displays. He suggests the need to discard the Saussure–inspired linguistics model for a more discourse–centered approach, which investigates meaning through practice. Bauer, 'Is what you see all you get'?

[95] Parpola, Koskenniemi, Parpola, & Alto, *Decipherment of the Proto-Dravidain Inscription*, p. 49.

[96] Knorozov, 'The Characteristics of the Language of the Proto-Indian Inscriptions,' p. 58.

> Successful decipherments have always been preceded by patient and often extensive preparatory work. In every case, it is eventually necessary to start guessing, but the method consists initially of proceeding as far as possible without making guesses. When the time for guessing comes, the range of guesses will have been limited by the preparatory analysis.[97]

The strength of the Finnish and the Soviet methods lay in their capacity, not only to locate clues for decoding the script, but also to detect clues in the corpus that allowed them to differentiate between the elements of an unknown system and to recognise their essence. This recognition becomes a elementary aspect of their method—the ability to not only read but also to recognise, in the unknown signification system, certain patterns that could be conducive to the production of evidence that proved their case. This recognition is not based on an empirical conception but numerous presumptions, essential for abductive inference:

> 1. One must recognise the object that the sign is presumed to represent; 2. One must recognise the meaning that the sign represents; 3. One must recognise the homophone, that is, the identity of the sound associated with the sign and the sound associated with the word to be understood.[98]

Rudimentary abductive logic was applied at every step of the Indus decipherment project. Both when the interpretative community, at the moment of discovery, decided to assume that the inscriptions found on steatite seals in the Indus were a script whose symbolic meaning was situated in its communicative materiality, and when the deciphers suggested that the script was of a proto–Dravidian.[99]

The works of the Finnish team and the Russian team were anticipated during the 1970s because of the hopeful possibility of the cryptographic imagination. Scientific method, mathematics, statistical analysis and the application of computers greatly increased the optimism and the confidence of the archaeologists. But both the teams were not able to produce substantial results. The application of more rigorous strategies did not bring forth radical insights.[100] Soon reviewers

[97] Parpola, *Deciphering Indus Script*, p. 61.

[98] Parpola, Koskenniemi, Parpola, & Alto, *Decipherment of the Proto-Dravidain Inscription*, p.10.

[99] This can been seen in the context of the interpretation of the [fish] sign by Parpola who explains his decipherment through an array of evidence that 'proves' his formula 'Fish = star: astral divinities' Parpola, *Deciphering Indus Script*, pp. 179–84. Also see Parpola, 'Task, Methods and Results in the Study of the Indus Script,' Parpola, 'Isolation and Tentative Interpretation,' Parpola, 'The Size and Quantity of the Indus Seals'; Parpola, 'The 'Fig Deity Seal' from Mohenjo-Daro'.

[100] Zvelebil critiquing the decipherment attempts of the Indus script between 1965 and 1980, begins his review by categorically stating: 'all of the scholars I am going to discuss claimed with bland assurance and conspicuous lack of modesty to actually have successfully done what they have

were critiquing their conjectures, and showed that the advance scientific methods did not produce the expected results.[101] By the mid 1990s, even Parpola had resigned to the fact that the script was unbreakable and agency of the failure was given to the lack of enough inscriptional evidence.[102]

Contemporary Cryptographic Intervention

The work of the Finnish and the Russian teams were anticipated favorably during the 1970s and although they were unsuccessful, the methods they employed had a significant impact on later decipherments. Cryptographic imagination emerged as the preferred practice of intervention. The decisive combination of science, statistical methods and computers became the standard *modus operandi* for decipherment.[103] Typically, these texts had sections devoted to the methodology of decipherment, explicitly mentioning the type of computers used, kind of programme developed and the statistical test applied.[104] The statistical data produced became the primary scientific justification in their decipherment narrative. Statements like 'statistical data firmly in hand, all we require is 'to break the code...'[105]

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not done. None of the proposed models of the 'decipherment' of Harrapan script and language has so far won general acceptance' See Zvelebil, 'Recent attempts at the decipherment of the Indus script', p. 151.

[101] For critiques of the Finnish decipherments see: Brice, 'Review Of: Decipherment of the Proto-Dravidain Inscription of the Indus Civilization: A First Announcement'; Emeneau, 'Review of the Finnish and Soviet Decipherments of the Indus Script Along with the Claim of Dieter Scrapel'; Gurov and Knorozov, *Review Of: Decipherment of the Proto-Dravidain Inscription of the Indus Civilization: A First Announcement 1969*; Zide and Zvelebil, 'Progress in the Decipherment of the Proto-Dravidain Indus Script'; Zide and Zvelebil, 'Review Of: Decipherment of the Proto-Dravidain Inscription of the Indus Civilization: A First Announcement'; Marr, 'Review of the Finnish Decipherment of the Indus Script, the First Three Special Publications of the Scandinavian Institute of Asian Studies'; Sircar, 'Review Of: Decipherment of the Proto-Dravidain Inscription of the Indus Civilization: A First Announcement'. For critiques of the Soviet decipherments see: Zide and Zvelebil, eds., *The Soviet Decipherment of the Indus Valley Script: Transaltion and Critique*; Zide and Zvelebil, 'Review Of: Proto-Indica: 1965 and Proto-Indica: 1968'; Sevoroskin, 'Review of the Finnish decipherment of the Indus Script'.

[102] Parpola, notes thirty years after he began the project: 'another drawback is the scantiness of the material. Numerous signs occur only once or twice, and it is difficult to ascertain or check their intended meaning from the contexts with any confidence. For these reasons, it looks most unlikely that the Indus will never be deciphered fully, unless radically different source material becomes available. That however must not deter us from trying'. Parpola, *Deciphering Indus Script*, p. 274.

[103] Kak, The Study of the Indus Script; Kak, 'A Frequency Analysis'; Mahadevan, *The Indus Script: Texts, Concordance and Tables*; Mahadevan, 'Terminal Ideogram in the Indus Script'; Mahadevan & Visvanathan, 'Computer Concordance of Proto-Indian Signs'.

[104] Mahadevan, and K. Visvanathan, 'Computer Concordance of Proto-Indian Signs'.

[105] Mahadevan, *The Indus Script: Texts, Concordance and Tables*, p. 12.

became essential to the rhetorical logic of such narratives since they legitimised the decipherment as a scientific effort. However, none of the decipherments were successful, and the Indus script continues to remain undeciphered.[106] Yet, the attempts to scientifically decipher it continue.

Most recently Farmer et al. employed statistical analysis of the signs as concrete evidence to claim that the Indus Script was not a linguistic script and that the Harappans were illiterate. Their paper emphasised scientific acuity and was a response to a larger process of saffronisation of the Indian past. It is around the late 1980s that historians and archaeologists closely associated with the Hindutva ideologies undertook project of the 'Aryanisation of the Indus civilisation'.[107] Their narratives forcefully attempted to interpret Harappan material culture as Vedic. This project provocatively argued against the migration of the Aryans from the west and for the indigeneity of the Harappans.[108] Central to their claim was that Sanskrit was native to South Asia and that Aryans were not only indigenous, but also architects of the Indus civilisation. As part of this project, of the numerous revisionist narratives, one was about the decipherment of the Indus script as Vedic Sanskrit, published in 2000. Written by N. Jha and N.S Rajaram, it asserted that the Indus script was proto–Sankritic and therefore justified that the Harappans were actually the authors of Rig Veda.[109] This claim was met with stiff resistance in the Indian press, spearheaded by Farmer and Witzel along with Romila Thapar and Iravatham Mahadevan.[110]

Appalled at the unscientific nature of decipherment, Steve Framer, along with Michael Witzel, Professor of Sanskrit at Harvard University and Richard Sproat, a computational linguist at Oregon Health & Science University intervened with their scientifically driven narrative. Employing comparative statistical methodology they show that in relationship to other languages of the ancient world, the Indus script had high prevalence of single signs, too few high frequency signs and were devoid of sign repetition within a single inscription. Using these arguments as the cornerstone of their thesis they also suggest that the lack of long perishable text and the brevity of known Indus inscriptions prove that Indus script was non-linguistic entity.[111] Their arguments, though assertive and rhetorically

[106] See Mahadevan, 'What Do We Know About the Indus Script?'

[107] Bhan, 'Aryanization of the Indus Civilization', p. 13; Guha, 'Negotiating Evidence'; Thakran, 'Implications of Partition', p. 62.

[108] See Rajaram, *The Aryan Invasion Theory*; Elst, *Update on the Aryan Invasion Debate*; Talageri, *Aryan Invasion Theory*.

[109] Jha & Rajaram, *The Deciphered Indus Script*.

[110] See Thapar, 'Hindutva and History'; Mahadevan, 'One sees what one wants to'; Witzel & Farmer, 'Horseplay in Harappa'. Also see Parpola 'Of Rajaram's "Horses"'.

[111] Farmer et al., 'The Collapse of the Indus-Script Thesis'.

put forward as scientifically robust, however have found ambivalent support.[112] Like the Finnish and Soviet decipherers, the employment of scientific method for Farmer et al. was not just a performance of producing objective knowledge but was also a political act, motivated by a need to civilise the unscientific terrain of Indus Script decipherment:

> The claim that historical fields follow methods different from those of other sciences is still frequently repeated. Given the political abuses to which history is subject, we consider this to be a dangerous claim, and believe that the same rigor must be demanded in history as in any other scientific field.[113]

Farmer et al. have been successful in pushing the discourse about the Indus script in a new direction by suggesting a possibility of a civilisation without writing culture, and thus have challenged the very concept of the Indus civilisation. However, their narrative, although underscored by rational scientific discourse, is not conclusive.

In 2009, to challenge their claim, the latest instance of the Indus script cryptographic intervention unfolded. A group of researchers consisting of computer scientists, astrophysicists and a mathematician from Tata Institute of Fundamental Research, Mumbai and the University of Washington, Seattle ran a series of statistical tests on the 1977 computerised concordance of Iravatham Mahadevan to show that unlike Farmer et al.'s claim, the Indus script was a linguistic entity.[114] Their strategy was a methodological mimesis of the Finnish and the Russian cryptographic imagination.[115] Employing statistical algorithms and contemporary computational cryptanalytical methods based on the mathematical theory of communication, they attempt to show that signs of the Indus script have the formal characteristics of a linguistic system.[116] Their immediate strategy was to refute

[112] During a presentation at the Thirteenth Harvard Roundtable on the Ethnogenesis of South and Central Asia Research Institute for Humanity and Nature in Kyoto, Japan on 31 May 2009, Steve Farmer claimed that he had received extensive support from linguists, archaeologists, script specialists and Indologists who haven't been associated with the script thesis. He also emphasised that their claims have only received private support from archaeologists who need government and public support to excavate at Indus sites. Also see Lawler 'The Indus Script—Write or Wrong? on the impact of their attempt.

[113] Farmer et al., 'The Collapse of the Indus-Script Thesis,' p. 48.

[114] See Rao et al., 'Entropic Evidence'; Rao et al., 'A Markov model'; Yadav et al., 'A statistical approach'; Yadav et al., 'Segmentation of Indus texts'; Yadav et al., 'Statistical analysis of the Indus script'.

[115] Yadav et al., 'Statistical analysis of the Indus script', p. 2.

[116] Their work emerges from the highly influential World War II cryptographer Claude Shannon's mathematically driven information theory and his usage of cryptography in communication systems. See Shannon, 'A Mathematical Theory of Communication'; *idem.*, 'Communication Theory of Secrecy Systems'.

the Farmer et al. claim.[117] Analogous to the Russian and Finnish conclusion they demonstrated that the Indus script has a syntactical structure 'with well-defined text beginners and text enders, directionality and sign order, and strong correlations between signs'.[118] They also suggest the missing signs of inscription in Mahadevan's concordance, employing statistical language processing algorithms.[119] However their attempt merely provides a robust statistical evidence for the linguistic nature of script—a claim that the Russian and the Finnish methods had shown forty years ago. Similar to Farmer et al. their work is not confirmatory. They do not prove that Indus script encoded a language, as much as Farmer et al. did not prove that Indus script is not a language. Both their works are sophisticated hypotheses that invoke science and mathematics to strengthen their interpretation. These contemporary decipherments are essentially mimetic derivatives of the cryptographic imagination that was initiated by the Russian and the Finnish works. Unlike the earlier decipherments, now cryptanalytical methods metamorphosed as computational linguistics has become a seemingly formidable model to decipher the script.

Conclusion

The project of decipherment of the Indus script emerged from the legacy of the colonial mission of producing knowledge about ancient India. The past of the colony was an unknown epistemic field that had to be comprehended and apprehended through discursive strategies—penetrative and intrusive, both conceptually and ideologically. This discursive ideology of uncovering was exacerbated in the context of an unknown script of an unknown language. Epistemologically, the decipherment had an effect of double inscription on the knowledge production mechanism. As a discourse, the Indus decipherment produced knowledge about the past in a framework that historically deployed a conceptual apparatus of colonial modernity in its methodology and theory. The subtext to this process was an

[117] They apply probability algorithms based on Shannon's mathematical theory of communication, to measure the degree of randomness (conditional entropy) found in Indus inscription and compare it with five known languages, and four non-linguistic entities—DNA sequence, bacterial protein sequences and two artificial control data. Their finding shows that conditional entropy of Indus script has closer affinity to linguistic system than non-linguistic system. See, Rao et al., 'Entropic Evidence'.

[118] Yadav et al., 'Statistical analysis of the Indus script', p. 212; Rao et al., 'A Markov model', p. 5; A similar claim was made by the Finnish team in 1981, see Koskenniemi, 'Syntactic Methods in the Study of the Indus Script'.

[119] Rao et al., 'A Markov model'; Yadav et al., 'Statistical analysis of the Indus script'. They also note that their future work would involve high order statistical algorithms and machine learning techniques to decode the grammar of the script.

attempt at inscribing an ideological construction of an Indian past through philological and epigraphical techniques. In its contemporary form, the double inscription of the colonial epigraphical project has transformed into a cryptological transnational, postcolonial project.

If the epigraphic intervention was colonial modernity's ideological engagement with ancient India, cryptographic imagination was a product of post-war ascendancy of transnational technological modernity. The goal of revealing the secrets of the past was mediated by scientific desires and it superseded nationalistic and parochial concerns. In the challenging epistemological world of the Indus script, the rise of the cryptographic imagination with the Russian and the Finnish attempts brought in positivist intervention to decipherment. The optimism of this approach pushed the discourse about Indus script to a new direction, however, not conclusively. In an already contentious epistemic location, the analogical epigraphic strategies were substituted with positivist rhetoric employing scientific driven algorithmic logic to justify interpretative decipherments. Forty years later, the cryptographic approach to the Indus script decipherment has become the standard strategy of decipherment. However, the script remains undeciphered. The failure to successfully decipher it is not a product of its practice but the transformation of the approach into a positivist trope. Cryptographic imagination represents a scientific thrust in the decipherment practice that reduces the past to a mathematical model having the possibility of predicting patterns. Here the algorithmic formulae emerge as rhetorical gestures to justify a decipherment narrative. Science is merely appropriated to justify interpretative claims. The reduction of a symbolic system into a mathematical code is probably not enough to decipher the enigma of the Indus inscription. It will require a radical epistemological reconfiguration of the script as a cultural system and not merely as a cipher that has to be decoded.

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