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Between Script and Symbol: A Critical Review of Indus Seal Interpretation, Decipherment Efforts, and Scholarly Traditions

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Abstract: This review article synthesizes the archaeological background of the Indus seals, the present status of decipherment, the major international interpretive traditions, and the profile of Chinese scholarship on the subject. Although the Indus seals are among the most iconic artifacts of the Bronze Age, no decipherment has yet won broad scholarly acceptance. A narrow but important consensus does exist: the inscriptions are very short; the predominant direction of writing on most seal inscriptions is right-to-left; the sign inventory is substantial but unstable because of allography, ligaturing, and segmentation problems; and no secure bilingual key has been found. Within language-based hypotheses, a Dravidian orientation remains the strongest mainstream candidate, not because it has solved the script, but because it aligns better than most rivals with cumulative philological work, substrate evidence, and regional historical plausibility. Sanskritic or Indo-Aryan decipherments, by contrast, often face chronological and methodological objections. The nonlinguistic thesis made an important critical intervention by exposing the weaknesses of many earlier decipherment claims, but it may overstate the negative case when it treats the absence of a conventional phonographic script as evidence that no structured linguistic or semi-linguistic coding was present. Recent semasiographic and administrative models have redirected attention from full translation toward institutional meaning, especially in relation to trade regulation, taxation, craft licensing, sealing practices, and access control. Computational and artificial-intelligence approaches have improved corpus management, allograph detection, image archiving, and the testing of structural claims, but they have not resolved the language question by themselves. Chinese-language scholarship has contributed through comparative philology, seal studies, and debates about whether writing should be treated as a universal criterion of civilization; independent Chinese-language decipherment claims also exist, but they have not been accepted internationally. The study argues that future progress will depend less on dramatic claims of complete decipherment than on a disciplined integration of archaeology, epigraphy, historical linguistics, seal-use contexts, and reproducible digital methods.

Keywords: Indus seals, Harappan civilization, decipherment, Dravidian hypothesis, semasiography

1. **Introduction**

The seals of the Indus or Harappan Civilization are visually distinctive, widely reproduced, and immediately recognizable, yet they continue to resist secure decipherment. In a single compact object, the classic Indus seal often combines image, inscription, material technology, and evidence of administrative practice(Figure 1). Because of this convergence, debates over the seals are never purely philological. They implicate archaeology, economic history, the formation of authority, interregional exchange, the definition of writing, and the linguistic ecology of Bronze Age South Asia [1] -[4] .

Figure 1, The seals of Harappan Civilization (Source: https://www.harappa.com/slide/seals-and-sealing)

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The central problem is easy to state and hard to solve. Thousands of inscriptions survive, but most are extremely short. The longest examples remain much shorter than the sustained texts that made the decipherment of Egyptian hieroglyphs, cuneiform, or Linear B possible. No bilingual inscription comparable to the Rosetta Stone has been found. The language, or languages, behind the sign system remain unknown. Even the size of the sign inventory depends on decisions about allographs, ligatures, damaged signs, and whether similar forms are counted separately or collapsed [1], [5], [12], [16].

For that reason, discussion of the Indus seals repeatedly cycles between optimism and restraint. New methods—from mid-twentieth-century comparative philology to statistical modeling and deep learning—often raise hopes of a breakthrough. Yet the field repeatedly returns to the same evidentiary bottlenecks. The most responsible contemporary position therefore begins not with a triumphant decipherment claim, but with a structured assessment of what is known, what remains disputed, and which kinds of argument deserve greater or lesser confidence.

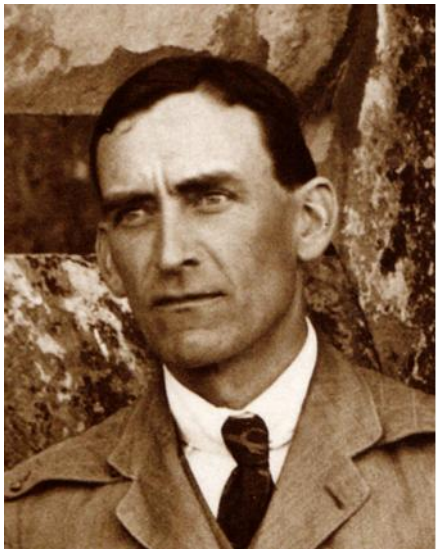
This study has five principal aims. First, it summarizes the archaeological and historiographical background of the seals. Second, it clarifies the current state of decipherment and identifies the limited areas of genuine consensus. Third, it surveys the major international interpretive schools, including Dravidian, Indo-Aryan or Sanskritic, multilingual and open-language positions, the nonlinguistic thesis, semasiographic-administrative models, and computational approaches. Fourth, it maps Chinese scholarship and Chinese-language interpretations, distinguishing academically grounded contributions from high-claim independent decipherment proposals. Fifth, it compares the strengths, weaknesses, characteristic features, and representative examples of these approaches in a form suitable for international scholarly discussion.

Methodologically, the Indus case also matters for the general theory of decipherment. Successful decipherments elsewhere normally depended on some combination of long texts, bilingual controls, identifiable proper names, or a known descendant language. The Indus corpus has none of these in a secure form. The appropriate lesson is not simply that "other scripts were deciphered, so this one will be too," but that other decipherments became convincing only when external anchors constrained the range of possible readings. In the Indus case, those anchors remain weak. That absence should alter not only our optimism but also the standards of proof that we apply to new claims.

A second historiographical point is equally important. The field is often narrated as a competition among rival translations, but in practice much of its genuine progress has come from activities that appear less dramatic: corpus curation, sign drawing, artifact cataloging, contextual excavation, critical review essays, and methodological critique. In a mature research culture, those activities should not be treated as secondary to decipherment. They are the precondition of any future decipherment that deserves acceptance.

2. Archaeological and Historiographical Background

The history of research begins with the gradual recognition of the Indus Civilization as an urban Bronze Age culture. Nineteenth-century notices of inscribed artifacts existed, but the civilization itself was publicly recognized only after excavations at Harappa and Mohenjo-daro under John Marshall in the 1920s [2]. From that point onward, seals quickly became one of the emblematic artifact classes of the civilization.



John Hubert Marshall (1876-1958) (Source: https://www.harappa.com/content/john-marshall)

Chronologically, the main body of seal inscriptions belongs to the Mature Harappan phase, conventionally dated to about 2600-1900 BCE, though precursor symbol systems and related marking practices may have earlier roots in regional pre-urban traditions [3], [18]. Geographically, the corpus spans a very large zone across present-day Pakistan and northwestern India, with links to regions farther west through trade and contact networks. This scale matters because any simplistic assumption of a small, linguistically homogeneous speech community becomes less plausible when the civilization is considered in its full regional extent.

The best-known objects are square steatite stamp seals bearing an animal motif above or beside a short inscription. Yet the corpus is not confined to one medium. Signs also occur on sealings, miniature tablets, pottery, copper implements, faience, stone objects, and occasional other surfaces [3]–[5]. The multiplicity of media complicates any account that treats the inscriptions as if they were a single text genre. A sign sequence on a stamp seal does not necessarily function in the same way as one on a sealing, a tablet, or a pot sherd.

Archaeologically, the object function of seals is prior to any decipherment proposal. Seals could mark identity, ownership, authorization, affiliation, or controlled access; they could be used in trade, storage, and regulated movement

of goods; and in some cases they may have carried amuletic or prestige value as well [3], [4], [20]. A seal, in other words, is an administrative and social technology before it is a purely epigraphic puzzle.

This point has major interpretive consequences. The brevity of the inscriptions, often treated as a weakness from a decipherment standpoint, may reflect not an incapacity for writing but the kind of information being encoded: names, titles, commodity classes, issuing authorities, ritual designations, destinations, or institutional categories. Equally, if some signs were semasiographic rather than purely phonographic, the sealing context would make that unsurprising. Seals often work by conventionalized compression.

The animal motifs on Indus seals have generated an enormous literature. The so-called unicorn, humped bull, elephant, rhinoceros, buffalo, and composite creatures recur with varying frequencies. At times the iconography has been enlisted directly in decipherment, as when scholars infer the meaning of adjacent signs through the image or attempt to identify ideological continuities with later South Asian religions. Yet the relationship between image and inscription remains underdetermined. The image may denote a clan, office, deity, commodity, or nothing of the sort; it may function indexically rather than narratively; and it may not map directly onto the text at all [4], [18], [20].

The field is bounded by several persistent constraints. First, the inscriptions are short: many consist of about five signs on average, though exact figures vary by corpus and counting convention [1], [5]. Second, the sign inventory is neither trivially small nor securely fixed. Depending on how allographs and compounds are treated, sign counts often cluster in the low hundreds, with about four hundred unique signs serving as a common point of reference in older discussions [1], [5], [16]. Third, no accepted bilingual text exists. Fourth, the underlying language or languages remain uncertain. Fifth, the sign order is structured rather than random, but structured sequence alone does not identify a language family or prove a phonographic writing system [12], [13].

These constraints explain why the field remains open. They also explain why claims of complete decipherment must be judged by unusually strict standards. Because short inscriptions are highly compressible, many systems can be made to yield plausible-looking local readings if the analyst permits enough flexibility in sign identification, reading direction, phonetic assignment, or semantic substitution.

3. The Current Status of Decipherment

The most important fact is negative: there is still no generally accepted decipherment of the Indus script [1], [18]. No proposal has yet produced a widely agreed sign list, directionality scheme, linguistic assignment, and translational method that can be applied consistently across the corpus and independently reproduced by other specialists.

It would nevertheless be wrong to conclude that nothing has been learned. A narrow scholarly consensus has emerged on several points. First, the predominant reading direction of most seal inscriptions is generally taken to be right-to-left, inferred from sign crowding, terminal behavior, layout conventions, and sealing practice [1], [5], [12], [13]. Second, the inscriptions display patterned positional and combinatorial behavior, making a purely random-symbol account untenable [12], [13]. Third, the corpus requires careful normalization, especially regarding allographs and sign segmentation [16]. Fourth, the archaeological context of seals, sealings, tablets, and standardization devices is central to the problem of meaning, not secondary background [3], [4], [14], [15].

Beyond that limited consensus, major issues remain unresolved. Scholars disagree on whether the system is fully linguistic, partially linguistic, semasiographic, mixed, or nonlinguistic. They disagree on whether one language underlies the corpus or several. They disagree on whether the inscriptions represent names and titles, institutional categories, commodity designations, ritual formulas, or some combination.

Recent progress has been strongest in four areas. The first is corpus handling: digital databases, image archiving, sign catalog refinement, and allograph identification [12], [13], [16], [17]. The second is statistical structure: work on entropy, n-grams, and positional distributions has clarified that the sign sequences are constrained in ways relevant to writing-like systems [12], [13]. The third is contextual integration: newer studies have tied inscriptional analysis to archaeological settings of sealing, gateways, workshops, storage, and standardization [14], [15]. The fourth is methodological critique: the most valuable skeptical scholarship has sharpened the criteria by which decipherment claims should be judged [7], [11], [18].

What has not occurred is the decisive leap from structural or contextual insight to broadly accepted translation. The field is therefore best described as having matured in infrastructure and argumentative discipline rather than having solved its central riddle. The strongest contemporary claims are usually better understood as models of function, structure, or likely language-family affiliation than as completed decipherments.

The greatest obstacles remain the classic ones: lack of bilingual texts, unknown language, and extreme textual brevity [1], [18]. To these must be added a fourth obstacle: underdetermination. Because the inscriptions are short and the sign inventory is debated, multiple explanatory models can fit portions of the evidence. A rebus reading, a title formula, a commodity tag, or a semasiographic administrative label may all seem plausible for the same short sequence. A valid decipherment would need to reduce ambiguity across the corpus, not merely generate attractive readings for a handful of examples.

4. Major International Schools of Interpretation

A convenient way to organize the international debate is to distinguish three analytical questions. The first asks what language family, if any, underlies the inscriptions. The second asks whether the system is fully linguistic writing, partial writing, semasiographic notation, or a nonlinguistic symbol system. The third asks what the inscriptions did in practice: identify people, offices, institutions, goods, routes, ritual categories, or fiscal obligations. Different schools of interpretation answer these questions in different combinations, and one reason the literature is often confusing is that they are not always separated cleanly.

The Dravidian orientation remains the strongest mainstream language-family candidate. This status does not mean that the script has been deciphered as Dravidian; it means only that, when linguistic substrate evidence, areal history, typological expectation, and the cumulative tradition of sign analysis are considered together, a Dravidian direction appears more plausible than most alternatives [1], [6]-[8], [18]. Classic figures include Henry Heras, Asko Parpola, and Iravatham Mahadevan. Parpola's work is especially influential because it combines sign analysis, iconographic interpretation, comparative philology, and archaeological awareness [4], [6]. The best-known example is the reading of the fish sign through a Dravidian rebus: fish, reconstructed as *min* or *meen*, may evoke star or celestial body through homophony. Even critics acknowledge that this example is intellectually elegant. Its weakness is that several stages of inference must all be correct at once.

Mahadevan's work contributed in a somewhat different but complementary way. In addition to foundational corpus work, he proposed readings of recurring sequences and argued that some sign strings may correspond to institutional designations such as merchants, city-based offices, or categories tied to dues and agrarian-economic life [7], [8]. Even where scholars reject the exact readings, many acknowledge the value of a method that begins with recurrent patterns rather than one-off visual speculation. The strengths of the Dravidian school are its cumulative character, its long philological history, its relative compatibility with the broader linguistic history of South Asia, and its attention to corpus behavior. Its weaknesses lie in the elasticity of the rebus method and in the fact that no Dravidian proposal has yet produced a translational apparatus that commands broad reproducible acceptance across the corpus.

Indo-Aryan or Sanskritic proposals form the principal rival language-family current. S. R. Rao is the best-known scholarly representative, and more recent internet or preprint literature has revived strong claims that the script records some early Sanskritic or proto-abugida system [10], [22]. The attraction of this line is obvious: if correct, it would dramatically alter conventional narratives about the linguistic history of South Asia. Yet these proposals face severe objections. The first is chronological. Mainstream historical linguistics does not support a straightforward equation of Mature Harappan epigraphy with an already established Vedic or classical Sanskritic writing tradition [1]. The second is methodological. Many Sanskritic decipherments map much later scripts or phonetic values retrospectively back onto the Bronze Age corpus. The third is selective validation: proposed readings often work only after signs are simplified, damaged images are regularized, or reading direction is altered.

The famous controversies surrounding N. Jha and N. S. Rajaram, especially the so-called horse-seal episode, made these weaknesses highly visible [7]. Similar concerns shadow more recent claims that the script has been fully decoded as a proto-abugida or early Sanskritic system [22]. In many such cases, the computational or cryptanalytic language sounds modern, but the evidentiary problem remains unchanged: the method does not generate a reproducible, archaeologically grounded, corpus-wide decipherment acceptable to independent specialists.

A third international tendency is better described as an open-language or multilingual position. Scholars in this camp do not claim to know the language, but they question the assumption that the entire corpus must derive from a single speech community. Given the geographical scale of the Indus Civilization, the diversity of its settlement network, and the general multilinguality of large ancient polities, it is plausible that more than one language circulated within Harappan society [18], [19]. The strength of this position is realism. It protects the field from premature closure and may explain why no single language-family hypothesis has produced a total solution. Its weakness is that it is often better at postponing error than at generating a directly testable decipherment strategy.

The most influential skeptical intervention is the nonlinguistic thesis advanced by Steve Farmer, Richard Sproat, and Michael Witzel [11]. Their argument was not merely that previous decipherments were weak, but that the premise of a full writing system may itself be mistaken. They pointed to the extreme brevity of the inscriptions, the large number of rare signs, the absence of long texts, and the lack of clear evidence for a scribal apparatus comparable to known literate civilizations. On that basis they proposed that the signs constituted a nonlinguistic symbol system serving political, religious, or social functions rather than encoding speech. This intervention was field-changing. It forced proponents of linguistic decipherment to justify why the system should be considered writing at all, and it exposed how many earlier claims depended on circular reasoning.

At the same time, the nonlinguistic thesis may overstate its conclusion. Ancient inscriptional systems do not all look like alphabetic or syllabic texts. Early marking systems, mixed notations, and tightly restricted administrative codes can all be extremely short and formulaic. The strongest criticism of the nonlinguistic thesis, therefore, is not that it asks the wrong questions, but that it may infer too much from the absence of long phonographic text. It remains possible that the Indus inscriptions encoded language, institutional semantics, or both, without conforming to the expectations built from later literary scripts.

One of the most significant developments of the last decade has been the emergence of semasiographic and administrative models, especially in the work of Bahata Ansumali Mukhopadhyay [14], [15]. Rather than asking first which spoken language lies behind the signs, this approach asks how the inscriptions functioned within Harappan institutions. The argument is that seals, tablets, and sealings behaved as formalized data carriers. Their inscriptions may have combined sign classes, positional conventions, and document-specific syntaxes to encode institutional meanings such as taxation, craft licensing, commodity control, or access control [14], [15]. The strength of this line is its close fit with archaeological reality. It explains why inscriptions are so short, why they recur in tightly formulaic patterns, and why they are tied to tiny portable objects used in handling goods, regulating spaces, or marking authority.

Computational and AI-assisted approaches have become indispensable, though they should not be oversold. Rao and collaborators used entropy measures to show that the sign sequences occupy a statistical range closer to natural language than to several comparison systems [12]. N-gram analyses refined those results by modeling local sequence behavior and sign prediction [13]. Daggumati and Revesz addressed the important problem of allographs, proposing ways to identify variant forms and reduce spurious sign inflation [16]. More recent machine-learning work has improved large-scale image archiving and the extraction of sign and motif information from seals [17], [30]. The strengths of these approaches are reproducibility, scale, and methodological transparency. Their limitation is equally clear: statistical structure and image recognition do not, by themselves, identify the underlying language or yield translation.

5. Chinese Scholarship and Chinese-Language Interpretations

Chinese scholarship on the Indus seals is much smaller than the Anglophone and South Asian literature, but it is intellectually distinctive. It can be grouped into four broad tendencies: comparative philology, seal studies and material-culture analysis, the civilization-criteria debate, and high-claim independent decipherment proposals. These tendencies should not be conflated. Some are careful scholarly interventions that make no claim of full decipherment; others explicitly claim to have solved the script.

Rao Zongyi (Jao Tsung-I) occupies a special place in Chinese-language discussion. Official biographical materials describe him as the first scholar to compare ancient Indus pictographic writing with Chinese-language materials and early Chinese graphism [23]. The significance of this work lies less in any accepted decipherment than in a comparative-philological imagination that treated the Indus material as part of a wider Eurasian history of sign formation. Its strength is breadth and intellectual courage; its weakness, from a strict decipherment perspective, is that visual or structural comparison across civilizations rarely supplies the external anchors needed for proof.

Table II. Chinese Scholarship and Chinese-Language Interpretive Tendencies

Scholar / tendency	Orientation	Contribution	Main limitation
Rao Zongyi	Comparative philology	Placed Indus signs in a wider Eurasian graphism context	Comparison alone does not produce proof
Pan Minzhong / Hu Qi	Seal studies / material culture	Treat seals as crafted objects with typology and use-context	Limited direct leverage on language assignment
Wang Wei / He Yun'ao	Civilization theory	Used the Indus case to question rigid civilization criteria	Theoretical rather than translational
Huang Yilu / Yabu	Independent decipherment claims	Strong public interest; ambitious proposals	Not accepted internationally; weak external controls

A different line is represented by scholars such as Pan Minzhong and Hu Qi, whose work approaches Indus seals primarily as seal objects, artifacts, and material-cultural documents [24], [25]. Pan's work indicates a sustained attempt to collect, classify, read, and contextualize the literature and objects within an explicitly seal-studies framework. Hu's work on steatite seals similarly treats them as part of seal culture and asks how material, form, and use illuminate their historical role. The strength of this Chinese contribution lies in object-centered rigor: it encourages scholars to take the seal seriously as a crafted tool, not merely as a line of signs detached from context. Its weakness is that it does not, by itself, solve the language problem; rather, it sharpens the archaeological and typological baseline for future interpretation.

A third Chinese contribution is more conceptual than epigraphic. Archaeologists such as Wang Wei and He Yun'ao have invoked the Indus case in broader debates about the emergence of civilization and the state [26], [27]. In broad terms, their argument is that one should not insist on writing, metallurgy, and cities as rigid universal criteria of civilization, because the Indus case demonstrates how a major urban civilization can possess an inscriptional tradition that remains undeciphered or contestably classified as writing. The value of this line is theoretical rather than translational: it makes the Indus seals relevant to comparative civilization studies, not only to philology.

Chinese-language public discourse also contains strong decipherment claims by independent researchers. Two examples are especially notable. One is Huang Yilu, who has been reported in Chinese media as claiming to have deciphered more than 2,500 Harappan seal texts through comparisons with cultural remains and divinatory traditions associated with Yunnan [28]. Another is Yabu (Cui Zhenzhong), who presents himself as a specialist in Harappan seal writing and claims to have deciphered roughly 140 signs by comparing them with oracle-bone inscriptions, bronze inscriptions, and broader Chinese classical traditions [29]. These proposals are important for mapping the Chinese-language reception of the Indus problem, but they have not been accepted internationally. Their strengths are ambition and comparative breadth; their

weaknesses are overreach, insufficient external control, and the same risk of retrospective projection seen in many high-claim decipherments elsewhere.

Taken together, Chinese scholarship contributes most credibly where it frames the problem, enriches the study of seals as objects, and brings comparative civilizational questions into view. It is much less influential internationally when it makes large translational claims unsupported by broadly accepted epigraphic method. The overall pattern mirrors the global field: the strongest contributions are usually infrastructural, contextual, or critical rather than declarative claims of complete decipherment.

6. Comparative Strengths, Weaknesses, Features, and Examples

Table I. Comparative Overview of Major Interpretive Schools

Approach	Core claim	Strengths	Weaknesses	Representative example
Dravidian	Language-family hypothesis; strongest mainstream candidate, but not a solved decipherment	Long philological tradition; regional plausibility; serious corpus work	Rebus method can be elastic; no corpus-wide accepted translation	Fish-sign / star rebus
Indo-Aryan / Sanskritic	Script records an early Sanskritic or Indo-Aryan language	Ambitious and explicit in translational intent	Chronological and methodological objections; often retrospective	S. R. Rao; later high-claim proposals
Nonlinguistic thesis	Signs are not full writing, but a nonlinguistic symbol system	Raised standards of proof; exposed weak claims	May overstate the negative conclusion	Farmer, Sproat, Witzel (2004)
Semasiographic-administrative	Signs encode institutional meaning more than sentence-like text	Best fit with seal contexts and very short inscriptions	Explains function better than spoken reading	Mukhopadhyay (2019; 2023)
Computational / AI	Tests structure, clustering, allographs, and image archives	Reproducible; large-scale; infrastructure-building	Structure is not translation	Entropy, n-grams, allograph detection

A synthetic comparison is more useful than any simple ranking. The Dravidian school has the advantage of cumulative philological depth, regional plausibility, and a long record of serious engagement with the corpus. Its characteristic feature is the use of rebus-based or pattern-based readings tied to South Asian historical linguistics. A representative example is the fish-sign reading associated with Heras and developed by Parpola. Its principal weakness is methodological elasticity: too many inferential steps can be left insufficiently constrained.

Sanskritic or Indo-Aryan decipherments have the advantage of internal ambition. They often attempt a complete and direct solution rather than a partial model. Their characteristic feature is retrospective mapping from later Indic linguistic or graphic systems back onto the Harappan corpus. Representative examples include the proposals of S. R. Rao and later strong-claim Sanskritic works. Their main weakness is the cumulative weight of chronological and methodological objections. They frequently depend on contested assumptions about linguistic history and on selective handling of damaged or ambiguous signs.

The nonlinguistic thesis has the advantage of methodological discipline. It challenged a field that had too often rewarded ingenuity without verification. Its characteristic feature is argument by absence and distribution: short inscriptions, many rare signs, no long texts, no clear scribal apparatus. A representative example is the 2004 intervention by Farmer, Sproat, and Witzel [11]. Its weakness is that it may turn a valuable critique of weak decipherment into a stronger denial than the evidence warrants. A restricted administrative or mixed sign system could still be highly structured without looking like literary writing.

Semasiographic-administrative models have the advantage of contextual fit. They begin with what seals actually did in archaeological contexts and then ask what type of information such objects were likely to encode. Their characteristic feature is institutional semantics rather than sentence translation. Representative examples are Mukhopadhyay's 2019 and 2023 studies, which connect inscriptional patterning with taxation, licensing, commodity control, and access control [14], [15]. Their weakness is that they explain function more effectively than they explain language. A user of this model can say what the inscriptions probably did without being able to specify how every sign was read aloud, or whether reading aloud was even central to their use.

Computational approaches have the advantage of reproducibility, corpus scale, and technical clarity. Their characteristic feature is that they test claims about structure, clustering, prediction, or sign variation. Representative examples include entropy studies, n-gram modeling, allograph detection, and image-archiving neural networks [12], [13], [16], [17], [30]. Their

weakness is that they are often mistaken for automatic decipherment. Structure is not translation; a strong model of sequence behavior does not tell us whether a sign means a title, a commodity, a place, a deity, or a grammatical particle. Chinese scholarship contributes most strongly in three specific ways. First, comparative philology and early graphism studies widen the conceptual horizon of the problem. Second, seal-studies scholarship restores the object character of the seal and resists reducing it to a detached line of signs. Third, civilization-theory debates use the Indus case to test assumptions about the relation between writing and state formation. Its weakness, where it exists, is the same weakness visible elsewhere: comparative ambition can turn into uncontrolled equivalence if visual or cultural similarity is mistaken for proof.

7. Representative Examples

The fish sign remains the classic test case. In Dravidian-oriented approaches, especially those influenced by Heras and developed by Parpola, the fish sign is attractive because it is common, visually identifiable, and semantically expandable through rebus into "star" or "planet" [6], [21]. This yields an elegant bridge between pictorial form and cosmological vocabulary. Yet that elegance should not be mistaken for closure. A plausible reading of one sign does not amount to a decipherment of the corpus.

Figure 3 The fish sign in Harappa Seals (Source: https://sindhishaan.com/gallery/manuscripts.html)

Mahadevan's treatment of recurring short sign sequences is significant because it is less dependent on a single pictorial guess and more dependent on recurrence and patterned usage [8]. If a compact sequence appears repeatedly on seal-like artifacts, then an office, title, corporate designation, or institutional label becomes a realistic possibility. This style of argument is methodologically stronger than isolated sign-by-sign readings because it relies on distribution and recurrence rather than on the suggestiveness of one graphic image alone.

The "horse seal" episode associated with Rajaram and Jha remains a cautionary example of how not to proceed [7]. The claim linked a supposed equid image and Sanskritic decipherment to sweeping civilizational conclusions. Critics argued that the image had been manipulated or misread and that the underlying epigraphic method was defective. The value of this episode, negative though it is, lies in showing how the standards of proof must rise when the claimed historical consequences are large.

Recent semasiographic-administrative work provides a different kind of example. Instead of forcing a line of signs into a spoken sentence, it asks why inscriptions cluster with gateways, workshops, storage areas, sealings, and standardization devices such as weights [15]. These associations suggest that at least some inscriptions functioned in regimes of regulated movement and authorization. Whether they named individuals, offices, commodity classes, or fiscal categories, their meaning appears tied to procedure, not to literary expression.

8. Discussion and Research Agenda

No further progress can be fully cumulative without better agreement on sign inventories, allographs, and sign segmentation. This does not mean imposing artificial uniformity; it means creating transparent, revisable conventions that allow scholars to know when they are disagreeing about meaning and when they are merely disagreeing about sign classification [16], [17]. A mature field needs versioned corpora, machine-readable metadata, and published rationales for every major grouping decision.

Too many decipherment discussions still treat archaeology as decorative afterthought. Future work should begin by asking what type of artifact carries the inscription, where it was found, what associated materials were present, whether there is evidence of sealing action, and how the inscription fits within broader regimes of storage, movement, production, or ritual [3], [4], [15], [18]. Once object-context becomes primary rather than supplementary, many extravagant readings immediately become less plausible.

The most valuable future computational work will not be a magical "AI decipherment," but controlled testing of competing hypotheses. Models can test whether a proposed sign grouping improves predictive fit, whether a hypothesized prefix or suffix behaves distributionally as claimed, whether certain sign classes correlate with specific object types, or whether iconographic classes co-vary with inscriptional classes in a statistically meaningful way [12], [13], [16], [17], [30]. Such work can eliminate bad hypotheses and refine good ones even when full translation remains unavailable.

A further research priority is comparative restraint. Cross-civilizational comparison is useful only when similarities are anchored in chronology, transmission pathways, and technical detail. Otherwise, resemblance between an Indus sign and an early Chinese graph, or between an Indus animal motif and a later Hindu icon, remains suggestive but weak. The field does not need more ambitious analogies unless those analogies come with stronger mechanisms of proof.

Finally, progress will likely come from convergence rather than from any single spectacular insight. The next durable advance may look modest: a smaller, cleaner sign list; a more secure class of allographs; a better-argued functional syntax for seal legends; or a statistically validated link between inscriptional pattern and object context. Such results may lack the drama of a total decipherment claim, but they are precisely the kind of advances from which a real decipherment, if it comes, would have to grow.

9. Conclusion

The Indus seals remain among the most demanding artifacts in world archaeology because they sit at the intersection of image, authority, exchange, administration, and language. Their inscriptions are not random, and the field has learned much about their structure, recurrence, and material setting. But the script is still not deciphered in any strong, generally accepted sense [1] , [18] .

The most balanced judgment available today is therefore layered. A Dravidian direction remains the strongest mainstream language-family orientation, but not a demonstrated solution. Sanskritic or Indo-Aryan decipherments continue to attract attention, yet they face major chronological and methodological objections. The nonlinguistic thesis permanently improved methodological rigor, even if it likely overshot in treating the absence of conventional long-form writing as proof of total nonlinguisticity. Semasiographic-administrative models currently offer the strongest explanation of how such short inscriptions could function effectively in Harappan society. Computational approaches have transformed the technical basis of research, but they have not eliminated the need for archaeology, epigraphy, and historical linguistics. Chinese scholarship has made worthwhile contributions through comparative philology, seal studies, and theoretical reflection on civilization, while also displaying the same global pattern in which high-visibility decipherment claims outpace scholarly acceptance.

The field should therefore resist two temptations: declaring victory on inadequate evidence, and converting skepticism into blanket impossibility. Between those extremes lies the more productive path—slow, cumulative, interdisciplinary, and methodologically explicit. That path is less dramatic than a sensational decipherment claim, but it is the only one likely to produce results durable enough for international scholarship.

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