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## A study on the history of indexing in India

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### ABSTRACT

*A study on indexing extends to a wide arena of the process of publication, citation, information retrieval, information storage and knowledge management as a whole. The following research is inspired from the culture & practice of valuing knowledge in India. The study has been done on the backdrop of the evidences that historians provide about the rich knowledge and advancements that India contained during the ancient times. Invasions and colonializations have, to a great extent been impetus in its loss along with the passage of time and generations. The study here has been a product of extensive reading, analysis and research into the ancient knowledge and its management systems. The findings and observations have been presented in the order of the eras in the Indian history. The evidences collected from the first-hand sources adds more value to the observations.*

**Keywords**— Indexing, Information Retrieval, Information, Ancient India, History, Knowledge

### 1. INTRODUCTION

The word 'index' has a Latin origin and it means an alphabetical list of names, subjects, etc. with reference to the pages on which they are mentioned or an alphabetical list by title, author. One such example is a library where you have a collection of books or documents. Few of the synonyms used for the term include - register, listing, directory, table of contents, etc.

In terms of publishing, an 'index' is a list of words or phrases (headings) and associated pointers (locators) to where useful material relating to that heading can be found in a document or collection of documents. Indexing (originally called Cataloguing) is the oldest technique to identify the contents of items to assist in their retrieval. The objective of cataloguing is to give access points to a collection that are expected and most useful to the users.

A citation index is a kind of bibliographic index, an index of citations between publications, allowing the user to easily establish which later documents cite which earlier documents. A bibliographic index is a bibliography intended to help find a publication. The history of citation indexing also involves the history of information storage, information retrieval, documentation and knowledge management. Biblical citations in rabbinic literature (entire span of writings by a spiritual leader or religious teacher in Judaism throughout Jewish history) are the earliest known citation index. Institute for Scientific Information (ISI) founded by Eugene Garfield introduced the first citation index for papers published in academic journals. Eugene Garfield was an American linguist and businessman, one of the founders of bibliometrics (use of statistical methods to analyse books, articles and other publications) and scientometrics (concerned with the quantitative features and characteristics of science and scientific research).

Writing is the key element that separates the history of India into 2 broad periods - prehistoric (before the emergence of writing) and the historic (after writing). Below the important classifications of the various eras in Indian history.

### 2. AN OVERVIEW OF THE ERAS IN INDIAN HISTORY

1. Prehistoric era (until c. 3300 BC)
  - 1.1. Paleolithic
  - 1.2. Mesolithic
  - 1.3. Neolithic
2. Bronze Age – first urbanisation (c. 3300 - c. 1800 BC)
  - 2.1. Indus Valley Civilisation
3. Iron Age - Vedic period (c. 1500-600 BC)
  - 3.1. Vedic society
4. Second urbanisation
  - 4.1. Buddhism and Jainism

- 4.2. Mahajanapadas
- 4.3. Nanda Empire and Alexander's campaign
- 4.4. Maurya Empire
- 4.5. Sangam period
5. Classical and early medieval periods (c. 200 BC - c. 1200 AD)
  - 5.1. Early classical period (c. 200 BC - c. 320 CE)
  - 5.2. Classical period: Gupta Empire (c. 320-650 AD)
  - 5.3. Early medieval period (mid 6th C.-1200 AD)
6. Late medieval period (c. 1200-1526 AD)
  - 6.1. Delhi Sultanate
  - 6.2. Vijayanagara Empire
  - 6.3. Regional powers
7. Early modern period (c. 1526–1858 AD)
  - 7.1. Mughal Empire
  - 7.2. Marathas and Sikhs
  - 7.3. European exploration
  - 7.4. East India Company rule in India
8. Modern period and independence after c. 1850 AD)
  - 8.1. Rebellion of 1857 and its consequences
  - 8.2. British Raj (1858–1947)
  - 8.3. Indian independence movement (1885–1947)

## **2.1 Pre-Historic Era**

As the name suggests, the technology in the pre historic period was primarily based on stone. Economically, the palaeolithic and mesolithic periods represented a nomadic, hunting-gathering way of life, while the neolithic period represented a settled, food-producing way of life. Subsequently copper was introduced as a new material and this period was designated as the chalcolithic period. The invention of agriculture, which took place about 8000 years ago, brought about dramatic changes in the economy, technology and demography of human societies. Agriculture led to the emergence of villages and towns and brought with it the division of society into occupational groups.

## **2.2 Developments During the Pre-Historic Era & Some Important Timelines: A Global Note**

On a global perspective, agriculture, art and religion all became more sophisticated, and writing systems and written documentation, including alphabets, began to emerge, ushering in the Early Historical Period. Organized government, law and warfare, as well as beginnings of religion, came into play during the Bronze Age, perhaps most notably relating to the ancient Egyptians who built the pyramids during this time. The earliest written accounts, including Egyptian hieroglyphs and petroglyphs (rock engravings), are also dated to this era. During the classical and early medieval periods, the major works contributed by the Greek and Roman scholars are - tables of contents, alphabetization and hierarchies of information; on the global front. A massive work written by Pliny the Elder titled *The Natural History* comprised about 37 Books in which the entire first book of the work is nothing more than a gigantic table of contents in which he lists, book by book, the various subjects discussed. He even appended to each list of items for each book his list of Greek and Roman authors used in compiling the information for that book. Pliny, in the same book, has mentioned that this practice was first employed in Latin literature by Valerius Soranus, who lived during the last part of the II century B.C. and the first part of the I century B.C.

Researchers say that alphabetization was first devised by Greek scholars of the III century B.C. at the library of Alexandria in Egypt in order to help them organize the growing numbers of Greek literary works.

The works of Valerius Maximus, Marcus Julius Frontinus (a Roman senator), and Aulus Gellius employed arranging material under headings in order to make the writing more user friendly and easier to consult. These works were divided into multiple books, wherein each book is subdivided into chapters, and each chapter had its own heading, and all entries within that chapter contained extracts and anecdotes taken from ancient literature and history which illustrate that idea. Before the invention of printing in the fifteenth century book indexing had limited use as no two copies were the same nor with the same pagination.

Timelines in history with respecting to information retrieval, publishing and indexing:

- 1460 - beginning of the era of printing; printed book indexes started appearing. Developments in field of medicine were aided by indexes to medical texts and herbals.
- 1544 - publishing of the first printed Biblical concordance was published in 1544; however, its compiler was burned for heresy (opinions being in contrast with the then religions doctrines).
- 1737 – first publication of ‘Complete concordance to the Holy Scriptures’ - a concordance by Alexander Cruden which is still in print.
- 1755 – first index to the English language - ‘A Dictionary of The English Language’ by Samuel Johnson
- The 19<sup>th</sup> century marked the various attempts to codify indexing
- 1877 - The Index Society was formed in London with the aim of creating ‘a general index of universal literature’
- 1878 - Dr Henry Benjamin Wheatley wrote ‘What is an indexer?’. The Wheatley Medal, by Society of Indexers and the then Library Association (now the Chartered Institute of Library and Information Professionals – CILIP), is named after this same author. This medal was to recognise and encourage excellence in indexing.
- Women started entering the field, soon after this

- 1957 - Society of Indexers was formed in Great Britain
- Around the same timeline:
  - United states - William Frederick Poole began his Index to periodical literature. This was the first of many printed indexes published by the H. W. Wilson Company and others.
  - Belgium - Paul Otlet began the Universal Bibliographic Repertory — a universal index of all knowledge
    - Otlet wrote ‘Traité de documentation: le livre sur le livre, théorie et pratique’ which describes a system by which knowledge would be projected on one’s individual screen so that ‘in his armchair, anyone would be able to contemplate the whole of creation or particular parts of it. This shows that Otlet anticipated the Internet.
    - This index contained over eleven million entries backed by text files and illustrations
- Founding of other societies:
  - 1968 - American Society of Indexers
  - 1976 - Australian Society of Indexers
  - 1977 - Indexing and Abstracting Society of Canada
  - 1991 - China Society of Indexers
  - 1994 - Association of South African Indexers and Bibliographers
- 1976 – publishing of the British Standard on Indexing (BS3700:1976) – (still used throughout the English-speaking world, with its subsequent revisions)

### 2.3 Bronze Age

In, India, the first urbanization took place during the bronze age in the arid and semi-arid region of northwest India in the valleys of the Indus and the Saraswati rivers (dry Ghaggar-Hakra bed). This urbanization is known as the Indus or Harappan civilization which flourished during 3500–1500 B.C. The rest of India during this period was inhabited by neolithic and chalcolithic farmers and mesolithic hunter-gatherers. The Indus-Valley / the Harappan civilization saw the evidences of writing, documentation, information storage etc. The Harappan civilization is known for its scripts based on pictography. The signs comprise of birds, fish and a variety of human forms. The scripts were written boustrophedonically. Boustrophedon is a kind of bi-directional text, where, alternate lines of writing are flipped, or reversed, with reversed letters. The number of signs of the Harappan script is known to be between 400 and 600. The language of the Harappans is still unknown and must remain so until the Harappan script is deciphered (figures attached). (B, 2018)



**Fig. 1: Seal-Works (Indus Valley Civilization)**



**Fig. 2: Tools used to inscribe on seals-works (Indus Valley Civilization)**

### 2.4 Iron Age: Vedic Literature

The knowledge management during the iron age is studied and describe under the umbrella termed as the “Vedic Literature”. Writings, language, information storage and retrieval were important during the Vedic period. There are referencing to indices (known as Anukramanis in Sanskrit), found in the Vedas. Vedas are any of 4 collections (Rig Veda, Sama Veda, Yajur Veda, and Atharva Veda), forming the earliest body of Indian scripture, which codified the ideas and practices of Vedic religion and laid down the basis of classical Hinduism. Probably composed between 1500 and 700 BC, the Vedas contain hymns, philosophy, and guidance on ritual.

Anukramanis are the set of systemic indices of Vedic hymns that record the poetic metrics, content and traditions of authorship. The most important Anukramani is found in the Rigveda, named as Sarvanukramani. It records:

- The first word
- The number of verses
- Name and family of the poets (rishis)
- Names of the deities and metrics of each of the 1,028 hymns of the Rigveda

अनुक्रमणिका					
क्र०	विषय	पृष्ठ से तक	क्र०	विषय	पृष्ठ से तक
१.	भूमिका	५ - १५	१०.	नवम काण्ड	१ - ४०
२.	प्रथम काण्ड	१ - २४	११.	दशम काण्ड	१ - ४८
३.	द्वितीय काण्ड	१ - ३०	१२.	परिशिष्ट - १	१ - ८
४.	तृतीय काण्ड	१ - ३६		(अग्नि का सवित्र परिचय)	
५.	चतुर्थ काण्ड	१ - ४८	१३.	परिशिष्ट - २	१ - ३२
६.	पंचम काण्ड	१ - ५२		(देवताओं का सवित्र परिचय)	
७.	षष्ठ काण्ड	१ - ६८	१४.	परिशिष्ट - ३	१ - २०
८.	सप्तम काण्ड	१ - ४६		(इन्द्र का सवित्र परिचय)	
९.	अष्टम काण्ड	१ - ३८	१५.	परिशिष्ट - ४	४९७ - ५२०

Fig. 3: An Anukramanika (All World Gayatri Pariwar)

There were some sages dwelling in the forests who explained the Vedic scriptures to their pupils in the form of Aranyakas (Aranyaka means belonging to the forest) and they came to be known as “forest texts”. They explain metaphysics and symbolism of sacrifice. They are the forest books and were taught in the forests due to their magical powers. The Rig-Veda is considered as the oldest and is divided into 10 books or Mandalas. The Rig Veda is also said to have many things in common with the Avesta - the oldest text in Iranian language. Rig Veda is the earliest specimen of any Indo-European language. The Yajur-Veda is ritualistic written in prose. The Sama-Veda is a collection of melodies. The Atharva-Veda, the latest of the Vedas, is a book of magical formula with a collection of collection of 711 hymns, it is divided into 20 Kandas.

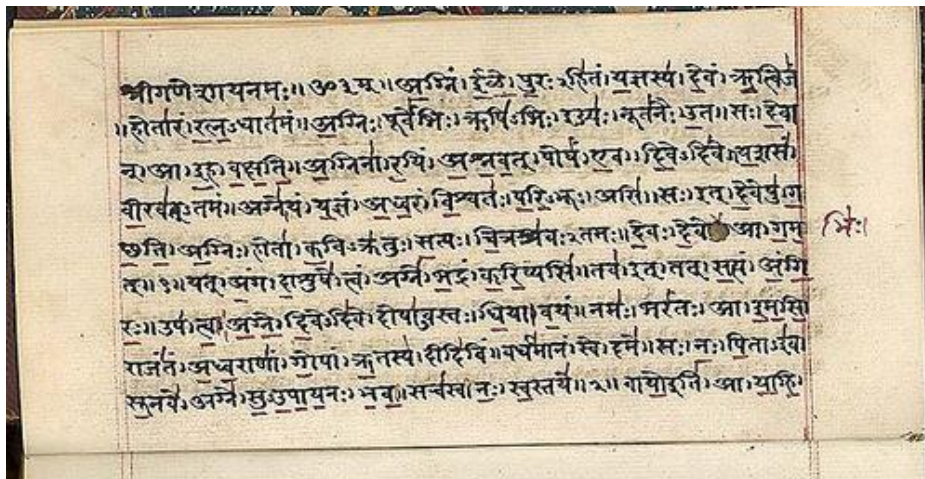


Fig. 4: A Rig Veda Scripture (Violatti, 2018)

The Upanishads are ancient Sanskrit texts of spiritual teaching and ideas of Hinduism. They are the part of the oldest scriptures of Hinduism, the Vedas, that deal with meditation, philosophy, and spiritual knowledge. There are 108 Upanishads.

In an attempt to convey to the future generations, the ancient and contemporary literature, the Aryan sages invented a special concise method called the Sutra style. Thus, the massive Vedic texts were condensed into short formulae, which could be easily remembered and transmitted orally - from father to son or from Guru (teacher) to Shisya (student). Most of the Vedic literature was handed down orally in this manner. The Sutra literature is divided into three classes: Srauta Sutras, Griha Sutras, and Dharma Sutras. The Kalpa Sutras treatises dealing with Vedic rituals on one hand, and with customary law on the other They are written in a laboriously compressed style, sometimes approaching the structure of algebraic formulas, unintelligible without the help of authoritative commentaries. Other treatises include the Dharma Shastras, Vedangas, and the Upvedas. (Jeywin)

### 2.5 The Indian Epics

Mahabharata reflects the state of affairs from 10th Century BC to 4th Century AD. Originally Mahabharata consisted of 8800 verses and was called 'Jayasamhita'. These were raised to 24000 and came to be known as Bharata. The final compilation brought the number of verses to 100,000 and came to be known as Mahabharata. The Ramayana of Valmiki originally consisted of 6000 verses which were raised to 12,000 and finally to 24,000. Composition of Ramayana started in 5th century BC. It passed through several stages and attained its present form as late as 12th century AD. The composition of The Ramayana by Valmiki, uses a special style of indexing. There are 24000 verses, derived from 24 letters respectively. These 24 letters are from a particular sacred chant in the Vedas that demonstrates the unity that underlies manifoldness in creation – The Gayathri Mantra. (Bloomfield, 1906)

### 2.6 Puranas

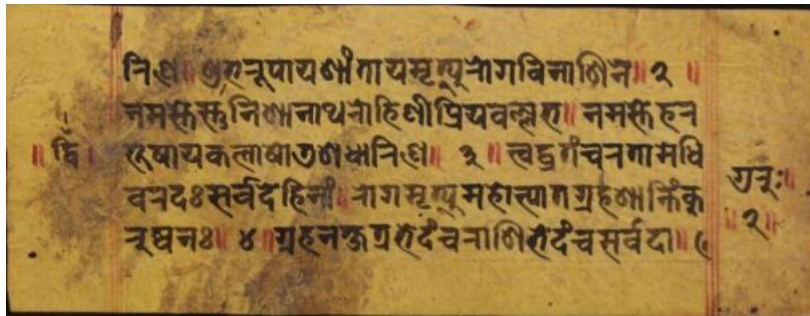
The strikingly varied nature of the contents of Puranas seems to be the result of diverse materials: tales, anecdotes, songs and ballads, traditional lore etc. These include mythology, cosmogony, various legends, genealogical accounts, folk beliefs, law codes and miscellaneous topics. The Puranic literature is thus a unique outcome of the ever-continuing synthesis of various socio-economic formations operative between the 5th century BC and the 12th century AD. Every addition in the Puranic literature brought in its train numerous new deities with images and temples, pilgrimages and vows, sects etc.

The period between 7<sup>th</sup> and 5<sup>th</sup> century BC was a turning point in the intellectual and spiritual development of the whole world, for it witnessed the emergence of early philosophers of Greece, the great Hebrew poets, Confucius in China and Zoroaster in Persia. It was at this time that Jainism and Buddhism arose in India, each based on a distinctive set of doctrines and each laying down distinctive rules of conduct for attaining salvation.

Many scholars place the end of the Iron Age in at around 550 BC, when Herodotus, “The Father of History,” began writing “The Histories,” though the end date varies by region. In Scandinavia, it ended closer to 800 AD with the rise of the Vikings. In Western and Central Europe, the end of the Iron Age is typically identified as coinciding with the Roman conquest during the first century BC. (Onion, Amanda; Sullivan, Missy; Mullen, Matt., 2019)

**2.7 Buddhism and Jainism**

Various scriptures were composed during this era. Vinaya Pitaka, Sutra Pitaka, Abhidhamma Pitaka, and the Khandhakas are the prime Buddhist scriptures. Among the non-canonical literature Milindapanho, Dipavamsa and Mahavamsa are important. The latter two are the great chronicles of Ceylon. The sacred literature of Svetambaras (one section of Jains) is written in a form of Prakrit called Ardhamagadhi, and may be classified as 12 Angas (parts) – 12 Uparangas, 10 Parikarnas, 6 Chhedasutras, and 4 Mulasutras.



**Fig. 5: Buddhist Sanskrit manuscripts (Thapa, 2013)**

**2.8 Mauryas**

Arthashastra, written by Kautilya/Chanakya (Chandragupta Maurya’s Prime Minister), primarily delves into the statecraft and administration. The treatise lays down various rules that should be formulated for a monarchy rule and strategies for a well-planned state economy. The Arthashastra has 15 adhikarnas (books). The first five deal with tantra (internal administration), the next 8 deal with avapa (relations with neighboring states), and the last 2 are miscellaneous in character. The current researches on Chanakya’s Arthashastra and specifically into the Neeti Shastra shows how cataloguing and recording of the contents were efficient during those times. Documentation and information storage were prominent during these times in the form on inscriptions (figure attached). (B, Ashoka's Edicts, National Museum, 2018)



**Fig. 6 Ashoka’s Edicts**

In A.D 1817, some British soldiers chanced upon a collection of caves in a horseshoe shaped ravine close to Aurangabad lying abandoned. This was when the Ajanta was exposed and left the world enthralled. Started in the second century BC and given up some time in the seventh century AD this complex of 29 chaitya and vihara caves were chiselled into live rock and are host to some of the best-preserved paintings and sculptures of the Gupta period. The themes of the paintings on the walls are religious in tone and centre around Buddha - the Bodhisattvas and the Jatakas. The depiction of the Jatakas and incidents from the life of Buddha (which offer visual representations of didactic themes to supplement the teachings of the elder monks to their pupils), offered the painter an unlimited scope (B, Jataka Tales, National Museum, 2018). This is yet another evidence of information storage and retrieval methods in ancient India.

Sakuntala, Malavikagnimitram, Vikramorvasiyatn, epics like the Raghuvamsa, and lyric poetry like the Ritu-Samhara and the Meghaduta written by Kalidasa in Sanskrit language, decorated by excellent figures of speech shows yet another evidence.



**Fig. 7 Jataka Tales (in the image, the story of the golden crab)**

Aryabhata's prominent works, which also lays down the evidence of the scientific knowledge and advancements the country possessed, is said to either lack a proper information storage and retrieval process or must have undergone destruction due to the multiple invasions. Suryasiddhanta, which dealt with epicyclic revolution of earth, nature of eclipse, reckoning of time etc, postulates that the Earth was a sphere rotating on its own axis and revolving around the Sun, postulates on the exact causes of eclipses, Heliocentric theory of gravitation (that predates Copernicus by almost 1000 years), and Aryabhata's Magnum Opus (the Aryabhatiya was translated into Latin) were the prominent works.

### **2.9 A Note on Takshashila**

As the oldest university in the world, Takshashila has a special place in the history of the world. Any note on literature and knowledge on ancient India is incomplete without mentioning the university of Takshashila, which, more so, in Indian history, became the greatest learning centre in the region, and allowed for exchanges between people from various cultures. At the time when this university was active, about 10,500 students from different parts of India and all across the world studied there. In this university, more than sixty different disciplines were taught including science, medicine, mathematics, astronomy, music, philosophy, religion etc. Chanakya (Kautilya) an advisor to Chandragupta Maurya was teacher at this university. Taxila produced many brilliant minds such as Panini (the great Sanskrit grammarian), Chandragupta Maurya (the great ruler), Kautilya (Chanakya) and Charaka (a popular physician of ancient India). (Naveed, 2015)



**Fig. 8 Remains of Takshashila University, Pakistan (Aayush)**

All the universities during the ancient India including Nalanda, Vikramshila etc were known for its brilliant & rich collection of knowledge and libraries.

### **2.10 The Library at Nalanda University**

The name Nalanda was derived from 3 Sanskrit words (Na-Alam-Da: meaning, no stopping of the gift of knowledge). One of their basic aims was to make a place for meditation to store and develop knowledge. (Abhi & Niyu, 2019).

The essence and purpose of knowledge management and information retrieval was known to us in the ancient period. The university encompassed multiple 9-storied library buildings, called as Dharma Kunj (meaning: mountain of knowledge), where monks meticulously copied books and documents so that individual scholars could have their own collections. According to accounts by pilgrim monks from East Asia and other historians, the curriculum in Nalanda University included study of Mahayana Buddhism, the Vedas, Logic, Sanskrit Grammar, Medicine, Samkhya, and more subjects on every field of learning along with more than 9 million manuscripts; showing the well-equipped indexing system.

Historians say that when the Nalanda university was set on fire by Bhaktiyar Khilji, it's library with lakhs of books were reburning for more than 3 months.



**Fig. 9: Site of Nalanda University (My India My Glory, 2020)**

### **3. LIMITATION**

The study has been limited to the classical and early medieval periods only. Eras like the Vijayanagara, Cholas, Cheras, Pandyas, Marathas and the transformations post the invasions are not included in this research. However, this could be carried out as future researches and studies.

### **4. CONCLUSION AND FUTURE STUDIES**

From its beginning the computer has been an assistant and backing in generating the current forms of indexes and made possible the establishment of large databases. In terms of the future, there is no critical need to develop new indexing techniques so much as there is a need to apply those which already exist more effectively especially in making the ever-increasing store of information accessible and convenient.

All the evidences point towards the fact that we had the knowledge before the rest of the world even had an idea about it. Books are not just pages printed with ink on them. Knowledge stored and managed in any form are time machines telling us about the past and warning us about our future, by guiding us in our present. Future researches could be conducted, to explore, study and assimilate the buried knowledge and also concord them under systematic indexing measures so that it is never susceptible to further burial or destruction irrespective of time.

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