

The Indian Knowledge System and National Education Policy - 2020: An integration of roots and wings for a Holistic Development

Sandeep Vansutre¹, S D Deshmukh², Farhaan Ahmad¹

¹(Department of Geology, Govt. NPG College of Science, Raipur, India)

²(Department of Geology, Govt. V.Y.T. P.G College, Durg, India)

Abstract:

This article seeks to explore the impact of ancient Indian practices on the development of a scientific mindset, whether they facilitated or hindered it. A comprehensive review is conducted to evaluate the contributions made in astronomy, mathematics, medicine, physics, geology, and technology during the ancient and medieval periods. The term 'Indian knowledge tradition' encompasses a vast and diverse body of information that has been acquired, preserved, and transmitted throughout thousands of years in the Indian subcontinent through various indigenous learning and inquiry methods. The Indian Knowledge System (IKS) is a systematic method of passing down knowledge from one generation to the next. The National Education Policy (NEP) of 2020 recognizes the rich heritage of ageless Indian philosophy and knowledge as a guiding principle. The Indian knowledge tradition has a long history of scientific investigation and discoveries dating back thousands of years. Under the umbrella of science in the Indian knowledge system, there are various disciplines including biology, physics, chemistry, medicine, astronomy, geology, and mathematics. Science in the Indian knowledge tradition is characterized by an integrated methodology, integration with philosophy and spirituality, and real-world applications aimed at enhancing human well-being. While the scientific contributions of ancient Indians have been acknowledged, ongoing research is focused on fully comprehending the breadth and depth of their achievements in the global history of science. This article provides a thorough analysis of science as an integral part of IKS. The National Education Policy (NEP) of 2020 promotes the integration of traditional Indian knowledge with modern scientific methods. The policy recognizes the potential for innovation through the fusion of IKS with modern technology, encouraging the establishment of startups and ventures that leverage traditional knowledge for sustainable development, wellness, and exploration of alternative energy in a technologically advanced society with human values.

Key Words: Indian Knowledge System (IKS), National Education Policy (NEP) 2020, Science, Modern Technology, Sustainable Development

Date of Submission: 14-06-2025

Date of Acceptance: 30-06-2025

I. Introduction

The National Education Policy 2020 (NEP 2020) places significant emphasis on integrating and revitalizing the Indian Knowledge System (IKS) within the modern education framework, acknowledging the value of India's ancient wisdom in today's world. By incorporating IKS into the education system, the policy aims to cultivate a generation that is academically proficient, culturally aware, and ethically grounded. The implementation of these initiatives is expected to play a crucial role in preserving and promoting India's rich intellectual heritage while equipping students with the knowledge and skills necessary for the future. NEP 2020 envisions a modern society with the foundation of IKS and the advancements of Modern Science, aiming to intertwine the two for comprehensive learning and development. Geosciences, including Geology and Geography, have their origins in IKS, similar to other scientific disciplines such as Ayurveda, Mathematics, Botany, Zoology, Chemistry, Physics, and Architecture. The fundamental knowledge of IKS in geological sciences can contribute to understanding, preserving, managing, and developing mineral and other natural resources for the benefit of humanity, aligning with the principles of sustainable development and the co-existence of flora and fauna.

II. Indian Knowledge System: A Concept for Conservation, Management and Development

The ancient Indian Knowledge system covers various branches of learning with a holistic approach, emphasizing the interconnectedness of all phenomena including 'jad and chetan' (matter and consciousness). It places a strong emphasis on spiritual growth and self-realization using symbolism, metaphor, and analogy. This knowledge system was developed through Shruti (oral tradition) and Guru-shishya Parampara (teacher-disciple lineage), highlighting its traditional roots. Notable figures in the ancient Indian Knowledge System include Aryabhatta in Mathematics and Astronomy, Charak in Ayurveda, Patanjali in Yoga, Kanada in Vaisheshika, Gautam in Nyay, and Bhaskara in Mathematics and Astronomy. The integration of science and spirituality in this knowledge system aims to address the rational and intuitive aspects of human experience, focusing on holism and explaining the interconnectedness of all phenomena. It also encompasses the concept of non-duality (Advait) which recognizes the unity of visible and non-visible or the unity of opposites (Matter-Spirit, Subject-Object). This understanding of nature and consciousness in the ancient Indian Knowledge System has become a popular and latest subject of research in modern science. Modern scientific research areas include quantum mechanics, where scientists study parallels between quantum principles such as entanglement and superposition with spiritual concepts like interconnectedness and non-duality. Cosmology is another area where researchers explore the origins and evolution of the universe, bridging scientific and spiritual perspectives. Neuroscience delves into the neural correlation of spiritual experiences such as meditation and consciousness with mental and physical well-being. Additionally, ecology studies the integration of spiritual values into environmentalism and sustainability, while geology and geography address the ethical uses of mineral resources for the benefit of mankind and their role in the development and management of different states on Earth. The ancient Indian Knowledge system provides a rich tapestry of wisdom that continues to inspire modern scientific exploration and understanding.

It is important to note that the subjects of study in modern science already existed in ancient Indian knowledge systems (IKS), where the interconnectedness of material and consciousness (prakriti and aatma, nature and soul) was emphasized. There are some beautiful examples to illustrate this point:

(i) **Shiv Tandav Stotra:-**

*जटाटवी गलज्जलप्रवाह पावितस्थले गलेऽव लम्ब्यलम्बितां भुजंगतुंग मालिकाम्।
उमडुमडुमडुमन्त्रिनाद वडुमर्वयं चकारचण्डताण्डवं तनोतु नः शिवः शिवम् ॥१॥.....*

The Shiv Tandav Stotra is a Hindu hymn believed to be composed by Ravana, a devoted worshipper of Lord Shiva. It delves into the portrayal of Shiva's cosmic dance, known as the tandava, and his diverse attributes. This dance serves as a representation of the cycle of creation, preservation, and destruction, emphasizing Shiva's immense power, beauty, and transcendence. Furthermore, the Stotra signifies the merging of opposites and the harmony of contradictions, elucidating the profound connection between the natural world and the divine, thereby revealing a deep and intricate relationship. It eloquently argues that consciousness cannot be separated from, but is an integral part of, the world, asserting that it emerges from the global workspace networks in the brain. In contemporary times, scientists are actively engaged in the field of neurotechnology and brain-computer interface, endeavoring to develop technologies capable of interpreting and generating neural signals. Moreover, extensive research is being conducted on artificial intelligence and consciousness, exploring the potential for conscious AI and its resulting implications. This modern research can be critically examined from the perspective of the interconnected and interdependent relationship between matter and consciousness, as elucidated in the aforementioned discussion of IKS.

- (ii) The Geetoupanishad, also known as the Gita, provides a compelling example of Lord Krishna's guidance to Arjuna during the great war of Mahabharata. Amidst Arjuna's dilemma and confusion, Lord Krishna revealed the Virat Roop to him, as described in Bhagavad Gita Chapter 11, to elucidate the ultimate reality beyond human comprehension. In this cosmic form, Lord Krishna manifested the entire universe, with innumerable heads, eyes, and limbs symbolizing omnipresence, omniscience, omnipotence, brilliance, and radiance. The intense light emitted by this form represented divine splendor and universal encompassment, encompassing all creation, including gods, demons, and humans, and transcending time, space, and causality. The dimensions of the Virat Roop exemplify the intricate interrelations and interdependency of mortal and immortal beings, serving as a reminder of the divine's majesty and our place within the grand cosmic design.

- (iii) Jigar Muradabadi, a renowned poet in Urdu literature, expressed in his couplets the transition from 'ishq-e-majazi' (love for human beings) to 'ishq-e-haqiqi' (love for God). His poetry elucidates the apparent and concealed manifestations of the divine in the natural world and the essence of nature.

“जिस रंग में देखा उसे, वह परदानशी है।

और उस पै यह परदा है कि परदा ही नहीं है ।
हर एक मकाँ में कोई इस तरह मुकी है।
पूछो तो कहीं भी नहीं, देखो तो यही है ।।”

- (iv) Another poet, 'Shad' Azimabadi (1846-1927), writes about the beautiful limitlessness of cosmic presence. He also elaborates on the multifaceted explanations that go beyond the limited vision that humans can comprehend.

“तेरे कमाल की हद कब कोई बशर समझा।
उसी क्रदर उसे हैरत है, जिस क्रदर समझा॥
न खुल सका तेरी बातों का एक से मतलब।
मगर समझने को अपनी सी हर बशर समझा॥”

III. Roots and Wings: Indian Knowledge System and Modern Science

1. **Astronomy :-** The astronomy in the Indian Knowledge System, known as Jyotisha, was highly advanced, with ancient Indian astronomers such as Aryabhata, Varahamihira, and Bhaskara II proposing models of planetary motion, solar and lunar eclipses, and accurate calendars. Texts like Surya Siddhanta laid the foundations for time reckoning, solstices, equinoxes, and celestial positions, reflecting an early understanding of the heliocentric model and trigonometric applications in sky mapping—principles central to modern astrophysics and space science.
2. **Mathematics** flourished independently in India, contributing concepts such as zero, the decimal system, algebraic equations, geometry, and trigonometric functions, found in texts like Lilavati, Bijaganita, and Sulbasutras. Scholars like Aryabhata, Brahmagupta, and Bhaskaracharya developed methods equivalent to modern calculus, iterative algorithms, and infinite series, which heavily influenced global mathematics through Arab and European transmission.
3. **Ayurveda**, a cornerstone of the Indian Knowledge System, is a comprehensive system of medicine covering physiology, pathology, pharmacology, surgery, and mental health. The Charaka Samhita deals with internal medicine, while the Sushruta Samhita is notable for surgical techniques, including cataract surgery and plastic surgery, and the tridosha theory (vata, pitta, kapha) relates to systemic balance in the body.
4. **Rasashastra**, or ancient Indian chemistry, involved the preparation of medicines using minerals and metals, distillation, sublimation, and purification processes, as well as exploration of mercury processing and metal alloying. Indian metallurgists pioneered techniques such as zinc distillation, rust-resistant iron, and sophisticated furnaces, laying the foundation for modern chemical engineering and materials science.
5. **Physics:-** The Vaisheshika school of philosophy, particularly through the work of Kanada, introduced a proto-atomic theory where matter was said to be composed of indivisible particles (paramanus). Theories of motion, light, heat, and sound were explored with remarkable depth, reflecting a metaphysical and analytical approach to nature corresponding to later developments in classical and quantum physics.
6. **Earth Science and Geology:-** In the Indian Knowledge System, Earth was viewed as a dynamic entity (Prithvi) in the Panchamahabhuta model, with ancient texts and thinkers describing soil types, mineral resources, hydrological cycles, and natural disasters. Concepts such as sustainable mining, earthquake awareness, and geomorphological observations in ancient texts have parallels with modern geosciences, showcasing the early understanding of Earth sciences and geology.
7. **Agricultural Science:-** Indian farmers historically practiced sustainable agriculture using detailed knowledge of soil texture, water availability, seasonal cycles, and crop diversity, as observed in texts like Krishi-Parashara and Vrkshayurveda. These practices are now re-emerging under modern agroecology and permaculture, highlighting the enduring wisdom of ancient agricultural science.
8. **Environmental Science:-** In ancient India, nature was treated with reverence, with forests, rivers, and wildlife considered sacred. There were widespread practices such as maintaining sacred groves, river conservation, and community-based forest management. Texts like Manusmriti laid down environmental ethics and responsibilities, reflecting a traditional ecological knowledge that aligns well with today's sustainability and conservation biology efforts.
9. **Metallurgy:-** India was a global leader in metallurgy, as evidenced by achievements like the Iron Pillar of Delhi, zinc smelting at Zawar, and sophisticated bronze casting during the Harappan era. Ancient metallurgists had mastered techniques such as carburization, alloy formation, and crucible steel production (Wootz steel), which are still studied today for their innovation and durability.
10. **Architecture and Civil Engineering:-** Vaastu Shastra provided guidelines for structural design, spatial planning, and orientation in harmony with nature and cosmic forces in the field of architecture and civil engineering. Harappan cities exhibited grid-based urban planning, drainage systems, and earthquake-resilient buildings, showcasing early understanding of structural design and urban planning.

11. **Linguistics and Grammar:-** The Ashtadhyayi by Panini represents one of the earliest known works of formal grammar, influencing modern computational linguistics and AI with its logical structure and production rules.
12. **Psychology and Mind Sciences:-** Indian systems like Yoga, Samkhya, and Buddhism deeply explored consciousness, cognition, emotions, and behavior, as seen in Patanjali's Yoga Sutras which discuss practices for mental clarity, emotional control, and spiritual development. These ancient practices have now been validated by neuroscientific research into meditation, mindfulness, and mental health therapies, reflecting the enduring relevance of Indian contributions to psychology and mind sciences.

A table of different branches of sciences, along with their Indian Knowledge System (IKS) perspectives, prominent contributors, and their integration with modern science can be illustrated as :

Branch of Science	Ancient Indian Knowledge System	Key Indian Contributors	Integration with Modern Science
Astronomy (Jyotisha)	Concepts of planetary motion, eclipses, time cycles (Yugas), nakshatras. Texts: <i>Surya Siddhanta</i> , <i>Aryabhatiya</i>	Aryabhata, Varahamihira, Bhaskara I & II	Celestial coordinate systems, planetary models, calendars, time zones
Mathematics	Decimal system, zero, algebra, trigonometry, geometry. Texts: <i>Sulbasutras</i> , <i>Lilavati</i>	Aryabhata, Brahmagupta, Bhaskaracharya, Pingala	Algorithms, calculus roots, trigonometric functions, coding theory
Medicine (Ayurveda)	Holistic health, tridosha theory, herbal pharmacology. Texts: <i>Charaka Samhita</i> , <i>Sushruta Samhita</i>	Charaka, Sushruta, Vagbhata	Alternative medicine, herbal drugs, surgery, public health models
Chemistry (Rasashastra)	Alchemy, metallurgy, distillation, dyes, perfumes, mercury processing	Nagarjuna, Patanjali, Acharya Kanad	Early chemical engineering, pharmaceuticals, metallurgy
Physics (Padarth Vigyan)	Atomic theory, motion, light, sound. Texts: <i>Vaisheshika Sutras</i>	Kanada, Prashastapada	Atomic structure, optics, acoustics
Geology & Earth Science	Panchamahabhuta, mineral knowledge, water cycles, earthquakes	Kautilya, Varahamihira, Rishi Agastya	Soil classification, mining, hydrology, earthquake studies
Agricultural Science	Soil types, crop cycles, rain prediction, organic manure. Texts: <i>Krishni-Parashara</i> , <i>Vrksayurveda</i>	Parashara, Surapala, Kashyapa	Sustainable agriculture, agro-climatology, permaculture
Environmental Science	Sacred groves, ecosystem balance, river and forest conservation	Rishi Kashyapa, Manu (Manusmriti)	Environmental ethics, biodiversity conservation, ecological restoration
Metallurgy	Extraction of zinc, iron, gold; rust-resistant iron pillar (Delhi)	Lohacharya, Zawar craftsmen	Advanced smelting, nanomaterials, corrosion resistance
Architecture & Engineering	Vaastu Shastra, town planning, water systems, earthquake-safe structures	Maya Danava, Viswakarma, Harappan engineers	Civil engineering, earthquake-resilient design, hydrological engineering
Linguistics & Grammar	Sanskrit grammar, logic, phonetics. Text: <i>Ashtadhyayi</i>	Panini, Bhartrihari, Katyayana	Computational linguistics, AI language models, NLP tools
Psychology & Mind Sciences	Meditation, mental health, yoga, consciousness studies	Patanjali, Buddha, Adi Shankaracharya	Cognitive science, mental wellness, mindfulness therapy

IV. Some Important Works of Scientists in IKS

- Sushruta, often considered the father of surgery, is credited with compiling a foundational text in Ayurveda.
- Charaka, another significant figure, is regarded as one of the principal contributors to Ayurveda, focusing on internal medicine in the Charaka Samhita.
- In the year 499 CE, Aryabhata estimated the distance of the Sun to be approximately 4,050,000 km (2,520,000 miles) in his book 'Aryabhatiya.' This estimation was remarkably close to the actual average distance, demonstrating Aryabhata's advanced understanding of astronomy and mathematics in ancient India. Aryabhata also assumed the Earth's circumference to be approximately 40,000 km (24,859 miles) and estimated the Moon's distance from Earth to be 258,000 km (160,000 miles). Using a combination of astronomical observations, mathematical calculations, and geometric methods, he arrived at these estimates. Furthermore, he calculated the Sun's distance to be about 15.7 times the Moon's distance, leading to his remarkable estimation of the Sun's distance as 4,050,000 km, which is only about 1.5% less than the actual average distance.
- Brahmagupta, another prominent mathematician and astronomer, made significant contributions to these fields as well.
- Bhaskara II, also known as Bhaskaracharya, authored the 'Siddhanta Shiromani' and contributed significantly to the field of astronomy.
- Varahamihira, a polymath, compiled the 'Panchasiddhantika,' which synthesized five earlier astronomical treatises.

- Rasa Shastra, an ancient Indian discipline, combines elements of alchemy and chemistry, contributing to the understanding of these fields.
- Kanada, the founder of the Vaisheshika school of philosophy, explored the concept of atoms (anu) as the fundamental building blocks of matter in his work 'Vaisheshika Sutra.' The 'Surya Siddhanta' stands as one of the oldest known texts on Indian astronomy, contributing to the understanding of celestial phenomena.
- Kautilya (Chanakya), the author of 'Arthashastra,' served as a key advisor to the first Mauryan emperor, Chandragupta. The 'Arthashastra' is a significant treatise on statecraft, economic policy, and military strategy.
- Nagarjuna, a renowned alchemist and philosopher, made significant contributions to the fields of chemistry and medicine.
- Takshashila, established in 700 BC, attracted over 10,000 students from various regions and boasted more than 2,000 professors offering education in 60 subjects.
- Nalanda, known for its vast collection of 90 lakh books, is believed to have had 2,000 teachers and 10,000 students during its existence from 427 to 1197 AD.

V. Vivekananda, an Ambassador of IKS

Vivekananda is renowned for introducing the creed of Indian Knowledge System, specifically Advaita Vedanta, to the modern world, emphasizing their compatibility and complementary nature. He believed that science and spirituality are two complementary aspects, with science exploring the external world through observation and experimentation, while spirituality focuses on the exploration of the inner world and consciousness.

- Vivekananda stressed the unity of all knowledge, transcending the boundaries of physical and metaphysical realms, aligning with the Advaita Vedanta philosophy's teaching that all is one and distinctions between matter and spirit are illusory.
- He advocated for a rational and scientific approach to spirituality, urging individuals to verify spiritual truths through their own experiences, much like the scientific method of observation, experimentation, and verification.
- Vivekananda's teachings appealed to both the scientifically minded and the spiritually inclined, as he believed that spirituality should be grounded in reason and that spiritual experiences could be systematically studied and understood.
- Vivekananda was a spiritual guru with strong scientific beliefs, introducing noble thoughts of the Indian Knowledge System and their vital importance for physical and spiritual development.
- In 1893, a conversation between Jamshetji Tata and Swami Vivekananda on science and human development led to the establishment of the Tata Institute of Science, now known as the Indian Institute of Science.
- In 1896, Vivekananda and Nikola Tesla had a profound conversation in New York, where they discussed the interconnectedness of all things and Tesla's vision of a world powered by wireless energy, potentially influencing today's wireless technologies.
- Vivekananda also met Lord Kelvin in London in 1896, where they discussed the concept of matter and energy, with Kelvin being impressed by Vivekananda's understanding of modern science.

VI. Buddhism and IKS

The Indian Knowledge System (IKS) and Buddhism have a deeply intertwined relationship, with Buddhism emerging in India around the 6th century BC and drawing from as well as contributing to the broader Indian intellectual and philosophical landscape.

- Buddhism, as a śramaṇa (ascetic) tradition, both critiqued and complemented Vedic orthodoxy, making profound contributions across multiple disciplines.
- In terms of philosophy and epistemology, Buddhism produced key texts such as the Tripiṭaka (Vinaya, Sutta, Abhidhamma) and gave rise to philosophical schools like Mādhyamika and Yogācāra, which developed doctrines of emptiness and idealism, respectively.
- Additionally, logical traditions such as Buddhist Logic (Pramāṇa) by Dignāga and Dharmakīrti influenced Nyāya, a school of Indian philosophy.
- Ethics and moral philosophy were also impacted by Buddhism, which emphasized the Eightfold Path and Middle Way, providing an ethical framework independent of ritualistic tradition and promoting values of non-violence, compassion, and mindfulness.
- Moreover, Buddhism made significant contributions to psychology and mind science, offering an advanced understanding of mental states, perception, cognition, and meditation techniques, as evidenced by concepts like Chitta, Cetasika, and Vipassanā.
- In the realm of education and logic, major Buddhist universities such as Nālandā, Takṣaśīlā, and Vikramaśīlā served as centers of multidisciplinary learning, covering areas including grammar, medicine, logic, metaphysics, and debate.

- Furthermore, Buddhism's influence extended to language and linguistics, as the use of Pāli and Sanskrit helped preserve vast scriptures, while Buddhist scholars contributed to semantic analysis and grammar.
- Buddhism also acted as a soft power, playing a role in spreading Indian knowledge to China, Japan, Tibet, and Southeast Asia, thereby preserving Indian Knowledge System (IKS) through the preservation of Buddhist texts in Tibetan and Chinese when they were lost in India.
- The conclusion presented in the original text is expanded and clarified to emphasize that Buddhism and IKS represent a symbiotic evolution of knowledge and that Buddhism, as part of the Indian Knowledge System, offered a rational, compassionate, and meditative approach to understanding life, mind, and society, continuing to influence global thought and research.
- Additionally, the contributions of other tributaries to the Indian Knowledge System, such as Sikhism, Jainism, Muslim Philosophy, Sufism, and various sects and saints from different Indian states, are acknowledged for their worthwhile contributions in conserving and developing the IKS, although they are not elaborated upon in this review paper.

The following table critically concise the works of Key workers of IKS, their works, integration with modern science.

Field	Ancient Scholar / Worker	Major Works / Contributions	Modern Science Integration
Geology & Geography	Varahamihira	<i>Brihat Samhita</i> – Earthquakes, rainfall, gems, soil, geography	Climatology, geomorphology, seismology, mineralogy
	Kautilya (Chanakya)	<i>Arthashastra</i> – Mineral classification, landforms, mines	Economic geology, natural resource management
Physics	Kanada	<i>Vaisheshika Sutra</i> – Atomic theory (Anu), motion, light	Atomic physics, classical mechanics
	Patanjali	<i>Yoga Sutras</i> – Sound, energy, motion through yogic science	Biophysics, neuroscience, energy studies
Chemistry	Nagarjuna	<i>Rasaratnakara</i> , <i>Rasendramangala</i> – Alchemy, mercury purification	Pharmaceutical chemistry, metallurgy, material science
	Acharya Charaka	<i>Charaka Samhita</i> – Drug formulation, organic chemicals	Medicinal chemistry, pharmacology
Biosciences	Charaka	<i>Charaka Samhita</i> – Human physiology, doshas, immunity	Human biology, immunology, preventive medicine
	Sushruta	<i>Sushruta Samhita</i> – Surgery, anatomy, dissection	Surgery, ophthalmology, anatomy
	Kashyapa	<i>Kashyapa Samhita</i> – Pediatrics and obstetrics	Child health, reproductive sciences
Mathematics	Aryabhata	<i>Aryabhatiya</i> – Pi value, algebra, sine tables	Trigonometry, algebra, number theory
	Brahmagupta	<i>Brahmasphutasiddhanta</i> – Zero, negative numbers	Arithmetic operations, algebraic rules
	Bhaskaracharya II	<i>Lilavati</i> , <i>Bijaganita</i> – Geometry, calculus elements	Algebra, calculus, mathematics education
Astronomy	Varahamihira	<i>Pancha Siddhantika</i> – Planetary motion, eclipses	Astronomy, astrology, celestial mechanics
	Aryabhata	<i>Aryabhatiya</i> – Earth's rotation, lunar eclipses	Heliocentric elements, orbital mechanics
Yoga & Psychology	Patanjali	<i>Yoga Sutras</i> – Mind control, cognition, meditation	Cognitive science, psychology, mental health
	Buddha	Mindfulness, Vipassana meditation, ethics	Consciousness studies, psychotherapy
Philosophy & Logic	Panini	<i>Ashtadhyayi</i> – Grammar, linguistic structure	Computational linguistics, formal logic
	Gautama	<i>Nyaya Sutras</i> – Logic, reasoning, epistemology	Philosophy of science, logic theory
	Adi Shankaracharya	<i>Advaita Vedanta</i> – Non-dualism, metaphysical principles	Consciousness studies, quantum philosophy

VII. Geology and Geography in IKS

The field of Geology within the Indian Knowledge System presents a fascinating intersection of ancient literature, cultural customs, and indigenous wisdom, integrated with contemporary scientific insights. The traditions of knowledge in India provide a profound historical context of observations and interpretations concerning the Earth's composition, minerals, and natural occurrences, many of which resonate with or anticipate modern geological theories.

1. Geology in IKS :-

- Vedas and Puranas: The Vedic texts, especially the Rigveda, include hymns that detail the creation of the Earth, as well as its mountains, rivers, and minerals. The Puranas, such as the Vishnu Purana and Matsya Purana, elaborate on the cosmological aspects and the formation of the Earth, outlining processes that can be associated with geological events.
- Agni Purana: This scripture mentions various types of soils, rocks, and their characteristics, which may be regarded as an early iteration of geomorphology.
- Manusmriti: The Manusmriti discusses various soil types and their appropriateness for agricultural practices, thereby addressing principles of soil science.

Here are some more examples and insights:

- The Concept of Mountains: The Rigveda elaborates on the formation of mountains through geological processes, particularly plate tectonics.
- Fossil Records: The Mahabharata references the existence of fossils within rocks, suggesting an awareness of ancient life forms.
- Mineral Resources: The Agni Purana outlines various minerals such as copper, iron, and gold, along with their methods of extraction.
- Geological Cycles: The Puranas discuss the cyclical characteristics of geological processes, including erosion, deposition, and uplift.
- Ancient Rivers: Both the Rigveda and Mahabharata refer to ancient rivers, notably the Saraswati River, which has been validated by contemporary geological studies.
- Volcanic Activity: The Mahabharata details volcanic eruptions and their impacts on the surrounding environment.
- Earthquakes: The Mahabharata and Rigveda provide accounts of earthquakes and their origins, particularly relating to tectonic activity.
- Mining and Metallurgy: India possesses a rich historical background in mining and metallurgy. Ancient Indian literature addresses the extraction of various metals, including gold, silver, and iron. The age-old practice of Rasa Shastra incorporates the utilization of minerals and metals in medicinal applications, demonstrating a comprehension of geology and mineralogy.
- Traditional Building Practices: The indigenous expertise regarding stone selection for construction, particularly in the context of selecting appropriate stones for temples, illustrates a profound understanding of the physical characteristics of rocks.
- Five Elements (Pancha Bhootas): The concept of the five elements—earth (Prithvi), water (Jala), fire (Agni), air (Vayu), and ether (Akasha)—in Indian philosophy can be related to the understanding of natural resources and elements. In Ramcharitramanas, the body is made up of these five elements-

“ छिति जल पावक गगन समीरा। पंच रचित अति अधम सरीरा ”

and a sher of Brij Narayan Chakbast goes as –

*“ जिंदगी क्या है अनासिर में जुहर-ए-तरतीब
मौत क्या है इन्हीं अज्जा का परेशाँ होना ”*

- This means that life consists of a careful organization of these five elements, while death represents an imbalance among them.
- Earthquake Theories: Ancient Indian texts discuss earthquakes and their causes. Theories found in works like the Brihat Samhita by Varahamihira suggest a rudimentary understanding of seismic activity and its effects

These instances illustrate a profound comprehension of geological principles within ancient Indian literature, frequently intertwining scientific observations with mythological and spiritual viewpoints.

Some Interesting Observations of Indian Culture deduced from IKS :-

- The practice of worshipping earth in the form of Ganesh and Durga Puja highlights the significance of soil in the ecosystem and agriculture.
- Numerous Indian pilgrimages are situated in the hills and mountains, emphasizing the importance of rocks, which showcase various geomorphological features and advancements in the prevention of natural ecosystem disruptions. The observation that idols of gods and goddesses are crafted from specific rocks reflects the ancient people's knowledge of selecting the appropriate stones for particular idols, demonstrating a connection to godly philosophy and authenticity.

- Furthermore, many Shivlings are constructed from quartz, known as Sphatik in Hindu literature. These crystal clear tectosilicates exhibit characteristic features of piezoelectricity and are devoid of cleavage planes.
- Anthropological museums also reveal that numerous weapons were crafted from stones such as Chert, Jasper, and Quartz, which possess the perfect conchoidal fracture.
- The Indian Knowledge System provides insights into how geological features have influenced cultural and religious practices. Sacred rivers, mountains, and stones in India often hold geological significance.
- The systematic and scientific planning of watersheds, in the form of talabs and ponds, demonstrates an intelligent application of utilizing surface water alongside groundwater for developing self-sufficient groundwater regimes.
- Notable examples include Chandi Baoli in Rajasthan and Rani ki Vav in Gujarat. The reverence for rivers like Ganga and Narmada underscores the utmost importance of water in people's lives, with many famous melas originating on the banks of these rivers.
- An intriguing example of astronomical knowledge in the Indian Knowledge System is the organization of Kumbh Melas every 12 years, indicating an understanding of Jupiter's orbit around the sun. The timing of the 'Simhastha Kumbh' corresponds to Jupiter's position in Simh rashi every 12 years.
- India's historical periods, from the Stone Age (7000 to 3000 BC) to the Bronze Age (3000 to 1300 BC) and the Iron Age (1200 to 26 BC), reflect the ancient civilization's familiarity with metallurgical processes and ore minerals, possibly predating other civilizations.
- The discovery of non-corrosive pillars, such as the Dhar Pillar, constructed by Bhoga (1000-1055 AD), attests to the ancient knowledge of chemical processes. The use of gemstones in astrology within the Indian Knowledge System has a rich history spanning thousands of years, with roots in ancient civilizations.
- Vedic Astrology, dating back to 1500 BCE, first mentioned gemstones in the Rigveda, a Hindu scripture, as a means to balance planetary energies.
- Around 500 BCE, Ayurveda utilized gemstones in traditional Indian medicine to treat physical and spiritual ailments.
 - In the Buddhist and Jain traditions, also around 500 BCE, gemstones were used in rituals and as talismans for spiritual growth and protection.
 - Arabic Astrology, emerging in 800 CE, introduced gemstones and emphasized their use in talismans and amulets.
 - By 1200 CE, Medieval Europe saw the use of gemstones in astrological talismans, influenced by Arabic and Greek traditions.
 - In 1500 CE, gemstones became an integral part of Hindu astrology, with detailed guidelines for selection and use.
 - Even in modern astrology, which began in 1900 CE, gemstones continue to be used in various traditions, with a growing emphasis on their metaphysical properties.
- Throughout history, gemstones have been used to balance planetary energies, enhance spiritual growth, attract wealth and prosperity, protect against negative influences, and promote physical and mental well-being. The main gemstones used in astrology include
 - Ruby/Manek for the Sun,
 - Pearl/Moti for the Moon,
 - Red Coral/Moonga for Mars,
 - Emerald/Panna for Mercury,
 - Yellow Sapphire/Pukhraj for Jupiter,
 - Diamond/Heera for Venus,
 - Blue Sapphire/Neelam for Saturn,
 - Hessonite/Gomed for Rahu, and
 - Cat's Eye/Lahsunia for Ketu.
- Gems and precious stones hold significant importance in Indian mythology, often symbolizing spiritual, mystical, and royal powers. For example, the Kaustubha is a divine gemstone said to be worn by Lord Vishnu, representing spiritual growth and enlightenment.
- The Chintamani, associated with Lord Ganesha, is a wish-fulfilling gemstone granting wisdom and prosperity.
- The Syamantaka, worn by Lord Krishna, symbolizes divine love and protection.
- The Navaratna, a nine-gemstone setting representing the nine planets and worn by royalty, is believed to bring balance and harmony.
- The Vajra, a mythical gemstone associated with Lord Indra, represents power and strength.

- The Maha Padma, a lotus-shaped gemstone worn by Lord Buddha, symbolizes spiritual growth and enlightenment. These gems are often mentioned in Hindu, Buddhist, and Jain mythologies, representing spiritual, mystical, and royal powers, and are believed to possess magical properties, granting wisdom, prosperity, and protection to their wearers.
- It is fascinating how our ancestral Rishis were able to correlate the moon and Mars with gemstones like pearl and coral, considering their aqueous origin. Modern scientific discoveries are now revealing the potential relation between the moon, Mars, and water bodies.
- The Koh-i-Noor is recognized as one of the largest and most renowned diamonds globally, boasting a rich history that extends over 800 years.
- Origin: -
 - It is believed that the Koh-i-Noor was extracted from the Kollur Mine located in the Kingdom of Golconda (now part of Telangana, India) during the 14th century.
 - Initially, it was owned by the Kakatiya dynasty and subsequently transferred through various rulers, including the Delhi Sultanate, the Mughal Empire, and the Sikh Empire. Currently, it is situated in the throne of the Queen of England at the Royal British Museum.
- Cutting: -
 - Originally, the Koh-i-Noor weighed 793 carats and was referred to as the "Syamantaka."
 - In 1756, the Mughal Empire reduced its size to 190 carats through cutting. - In 1849, the British East India Company acquired it and further cut it down to its present weight of 108.93 carats, a task undertaken by the Crown Jewellers.
- Cutting stages:
 1. Old Mine Cut (1756): A cushion-shaped cut weighing 190 carats.
 2. Old Brilliant Cut (1852): An oval-shaped cut weighing 108.93 carats, executed by the Crown Jewellers.
- The Koh-i-Noor is currently embedded in the coronation crown of the British Sovereign, which is displayed in the Tower of London.

2. Geography in IKS :-

Geography in the Indian Knowledge System (IKS) has a rich and profound history rooted in ancient texts, observation-based knowledge, philosophical thought, and spiritual worldview. Unlike modern Western geography, which is more quantitative and empirical, Indian geography historically integrated physical, cultural, spiritual, and cosmological elements.

- In the Indian Knowledge System, geography was understood through
 - descriptive geography (country, mountains, rivers, flora-fauna),
 - sacred geography (pilgrimage circuits, cosmic mapping),
 - environmental understanding (agriculture, monsoon, soils),
 - cultural geography (regions, people, customs), and
 - astronomical geography (cosmology, planetary mapping).
- The terminology and ancient sources in IKS geography include terms like Bhūgol, Diggaja, Kṣetra, and Dvīpas & Varṣas,
 - Bhūgol refers to the concept of a spherical Earth, with 'Bhu' meaning Earth and 'Gol' meaning Round or Sphere, representing an early reference to the Earth as a spherical body.
 - Diggaja symbolizes the elephant guardians of directions, serving as a metaphorical representation of spatial orientation.
 - Kṣetra denotes a sacred field or region, and is utilized in both spiritual and agricultural contexts.
 - Dvīpas and Varṣas are divisions of land in cosmology, as seen in examples like Jambūdvīpa in Purāṇas.
- These are found in key texts such as Vedas, Mahābhārata, Rāmāyaṇa, Purāṇas, Arthaśāstra, and Bṛhatsamhitā.
 - The Vedas provide detailed descriptions of rivers, seasons, and directions, such as the Rigveda mentioning Sapta Sindhu.
 - The Mahābhārata and Rāmāyaṇa offer comprehensive insights into regional geography, trade routes, and various kingdoms.
 - The Purāṇas, for example, the Vishnu Purāṇa and Bhāgavata, contain mythological cosmography and detailed descriptions of dvīpas.
 - The Arthaśāstra by Kautilya provides a wealth of information on resource geography, urban planning, and environmental considerations.
 - The Bṛhatsamhitā authored by Varāhamihira encompasses meteorology, hydrology, and spatial patterns in its content.

- The geography of ancient India encompassed key components, including physical geography, cultural and political geography, and astronomical and cosmological geography.
- In physical geography, the Himalayas and Vindhyas were considered both physical barriers and sacred landmarks, while rivers like Ganga, Sarasvati, Yamuna, and Sindhu were revered as sources of life and held significant religious importance. Ancient texts classified soils such as urvara and usar, along with discussing their fertility, and also detailed the concept of Ritus, which encompassed six seasons and monsoon cycles. Literature from that time also reflected an awareness of natural hazards like floods, droughts, and earthquake-like events.
- Cultural and political geography included the existence of Janapadas and Mahājanapadas, which were regional kingdoms with well-defined boundaries and capitals. Additionally, sacred geography was manifested through pilgrimage circuits linked to rivers, temples, and cosmic locations like Chār Dhām and Jyotirlingas, while trade routes like the Silk Route and Spice Route and port towns such as Lothal and Tamralipta played a significant role.
- Astronomical and cosmological geography was depicted through the Jambūdīvīpa Mandala, which described the Earth as concentric island continents with Mount Meru at the centre. Mount Meru, a cosmic mountain and axis mundi in cosmology, held both symbolic and geographical significance, while stellar and planetary mapping linked to Earth locations was also detailed through Nakṣatras and Lokas.
- The legacy and relevance of IKS geography today can be seen in the continued use of geo-spiritual mapping in pilgrimages, traditional ecological knowledge supporting sustainable land and water management, the revival of cultural geography in heritage studies, and the integration with GIS for mapping ancient places with modern tools.
- In conclusion, geography in the Indian Knowledge System offers deep insights into sustainability, climate understanding, and cultural integration with the land, going beyond mere land and maps to understand human-environment relationships, sacred landscapes, and cosmic orders.

VIII. Discussion and Conclusion

Combining the Indian Knowledge System (IKS) with contemporary science creates a significant synergy between conventional insights and methodologies grounded in empirical evidence. IKS, which has developed over centuries through careful observation and practice, includes various fields. Numerous aspects of these disciplines resonate with modern scientific principles. Contemporary science is distinguished by its accuracy, quantification, and use of technology while Indian Knowledge Systems (IKS) offer comprehensive viewpoints, emphasize sustainability, and provide solutions tailored to specific contexts. The incorporation of these elements fosters research across various disciplines, advocates for the appreciation of indigenous wisdom, and bolsters self-sufficiency (Atmanirbharta). This approach is particularly relevant in the fields of education, environmental management, rural development, and wellness, promoting a more inclusive, ethical, and culturally grounded practice of science. In summary, the integration of Indian Knowledge Systems with contemporary modern science fosters a synergistic framework that enhances creativity while respecting India's vast intellectual legacy. The ethical approach of Indigenous Knowledge Systems (IKS) to scientific development is crucial in today's world. We must consider the one-sided scientific development that lacks human values and its limited contribution to sustainable development. It is imperative to recognize the need for a balanced approach that integrates ethical considerations and human values into scientific progress.

IX. Acknowledgement

The authors are thankful to the Principal, Govt. NPG Science College, Raipur (C.G.) and Principal, Govt. V.Y.T. PG Autonomous College, Durg(C.G.) for their encouragement. Thanks are due to all the known and unknown researchers who have enriched the understanding about Indian Knowledge System and their Relation with modern Science in one way or the other.

References

- [1]. Agarwal, A. (1991). *Social, ecological and environmental movements in India. Development*, 34(4), 20–25.
- [2]. Chimwamurombe, P., Mapauré, I., & Claassen, P. (n.d.). *Understanding the relationship between indigenous (traditional) knowledge systems (IKS), and access to genetic resources and benefits sharing (ABS)*. University of Namibia.
- [3]. Gupta, A. (2024). A study of the scientific approach inherited in the Indian knowledge system (IKS). *The Scientific Temper*, 15(2), 2385–2389.
- [4]. <https://iks.cisindus.org/>
- [5]. <https://iksindia.org/ebook.php>
- [6]. <https://notes.collegehive.in/books/indian-knowledge-system/page/indian-knowledge-system-corpus-a-classification-framework>
- [7]. <https://radiancenews.com/indian-knowledge-system-an-overview/>
- [8]. Jha, S. (2013). *Indian Knowledge Traditions and Westernization: A Comparative Study*. New Delhi: Routledge.
- [9]. Joshi, Murli Manohar. (2003). *Science in India: A vision for the 21st century*. Ministry of Human Resource Development.
- [10]. Kapoor, K., & Singh, A. K. (Eds.). *Indian knowledge systems* (Vol. 1). Indian Institute of Advanced Study & D.K. Printworld.

- [11]. Kumar, A. (2019). Ancient Hindu Science. Jaico Publishing House
- [12]. Kumar, M. J. (2024). Forging Connections: Integrating Indian Knowledge Systems in Higher Education. IETE Technical Review, 41(3), 271–273.
- [13]. Nandikolmath, Dattaniranjana, and Aruna S. Hallikeri. *The Essence of the Tribal Knowledge System in the Indian Knowledge System*. Karnatak University Dharwad, n.d.
- [14]. Patnaik, R. (2013). *Geological heritage sites in India: challenges in conservation and management*. *Current Science*, 105(5), 587–593.
- [15]. Ravikumar, P. & Ghosh, S. (2022). *Bridging Traditional Indian Knowledge Systems and Contemporary Education: NEP 2020 Perspective*. *International Journal of Indian Education and Research*, 10(1), 1–9.
- [16]. Sharma, U. (2015). *Indian Knowledge Systems: Concepts, Perspectives, and Applications*. Delhi: Academic Press.
- [17]. Tiwari, S. *Indian Knowledge System (IKS) as a significant corpus of resources useful for personal and professional development*. *International Journal of Humanities and Social Science Invention*. Volume 12 Issue 9 || September 2023 || PP. 191-200