

Indian Knowledge Systems: The Central Plank of the New Education Policy

Soumitro Banerjee*

The National Education Policy 2020 (NEP-2020), which was accepted by the Union Cabinet on 29 July 2020 in the middle of the COVID lock-down, declares upfront, “The rich heritage of ancient and eternal Indian knowledge and thought has been a guiding light for this Policy”, and that this knowledge will be “put to new uses through our education system”.

But in the 66-page policy document, there is very little elaboration of what the policy-makers mean by the term ‘Indian Knowledge Systems’. In Clause 4.27, it says “Knowledge of India” will include knowledge from ancient India and its contributions to modern India and its successes and challenges”. “Indian Knowledge Systems, including tribal knowledge and indigenous and traditional ways of learning, will be covered and included in mathematics, astronomy, philosophy, yoga, architecture, medicine, agriculture, engineering, linguistics, literature, sports, games, as well as in governance, polity, conservation”. “An engaging course on Indian Knowledge Systems will also be available to students in secondary school as an elective”. This is all the document says regarding the ‘guiding light of the policy’.

Naturally, educationists who read the document had no clue of what was coming. But within months of the adoption of the

policy, it became clear that the ruling dispensation has a specific notion of what they are calling the “Indian Knowledge System”.

The first glimpse came in an International Webinar on Indian Knowledge Systems, which was organised by IIT Kharagpur from 6 to 8 November 2020. The inaugural programme was attended by many important government functionaries, including the Union Education Minister Mr Ramesh Pokhriyal ‘Nishank’, the Union Minister of State for Education Mr Sanjay Dhotre, the Secretary of Education Mr Amit Khare, Mr Atul Kothari of the Shiksha Sanskriti Uthyan Nyas and the Director of IIT Kharagpur, Prof V K Tiwari. Their speeches, now available on YouTube [1], made it clear that the government is inclined to project an imaginary glorious past of India without bothering about what is supported by evidence.

In February 2021, all Institutions under the Ministry of Education received a letter from the Ministry instructing them to organise programmes for disseminating the NEP-2020 in collaboration with an entity called ‘Bhartiya Shikshan Mandal’. In these programmes, the deliberations by the representatives of Bhartiya Shikshan Mandal focused almost exclusively on disseminating ‘India’s glorious past’ through the education system: the knowledge produced in ancient India that remains hidden as great treasures. The task before us, according to them, is to rediscover these treasures

*Dr Banerjee is a Professor of Physical Sciences at the IISER Kolkata and the General Secretary of *Breakthrough Science Society*.

and apply them in the present context. So they are advocating that all universities and research institutes take up the task of digging out those treasures.

For this purpose, the NEP-2020 proposes to mainstream Sanskrit in the education system. In Article 22.15 it states, “Due to its vast and significant contributions and literature across genres and subjects, its cultural significance, and its scientific nature, rather than being restricted to single-stream Sanskrit Pathshalas and Universities, Sanskrit will be mainstreamed with strong offerings in school — as well as in higher education. It will be taught not in isolation, but in interesting and innovative ways, and connected to other contemporary and relevant subjects such as mathematics, astronomy, philosophy, linguistics, dramatics, yoga, etc.”

Not only that. “Departments of Sanskrit that conduct teaching and outstanding interdisciplinary research on Sanskrit and Sanskrit Knowledge Systems will be established/strengthened across the new multidisciplinary higher education system. Sanskrit will become a natural part of a holistic multidisciplinary higher education if a student so chooses.” Plans are also in place for creating a body of teachers to make it happen. “Sanskrit teachers in large numbers will be professionalised across the country in mission mode through the offering of 4-year integrated multidisciplinary B.Ed. Dual degrees in education and Sanskrit.”

So, something called a “Sanskrit Knowledge Systems” will be imparted as a part of regular education, including science and engineering subjects.

The Ministry of Education has created a special cell for ‘Indian Knowledge System (IKS)’ at the All India Council for Technical Education (AICTE), which oversees the entire technical education in the country.

With its help, the AICTE has launched a Faculty Development Programme on IKS and has instructed engineering colleges to introduce courses on it. It has also advised universities and engineering institutions to introduce courses like *Sanskrit for Technical Knowledge, Value Education, Stress Management by Yoga, Personality Development through Life Enlightenment Skills*, etc.

Therefore, it seems improving various areas of education is not a matter of importance to the people in political power. Influencing the mindset of students with a particular fundamentalist ideology appears to be the prime objective of the New Education Policy 2020.

What do they believe are “Indian Knowledge Systems”?

What do the proponents of IKS mean by the term? What do they mean to include in the school and college curricula as components of the knowledge that existed in ancient India? If the NEP document does not spell it out, we have to figure that out from the statements of the leaders of the government on different occasions.

On 25 October 2014, in a programme held at a private hospital in Mumbai, Prime Minister Narendra Modi claimed, “We can feel proud of what our country achieved in medical science at one point in time. We all read about Karna in the Mahabharata. If we think a little more, we realise that the Mahabharata says Karna was not born from his mother’s womb. This means that stem cell technology was present at that time.” He continued: “We worship Lord Ganesha. There must have been some plastic surgeon at that time who placed an elephant’s head on the body of a human being.” [2]

In the 102nd Indian Science Congress held on January 3–7, 2015, a ‘paper’ was presented by someone named Captain

Anand J Bodas claiming that there were aeroplanes in the Vedic age. According to him, in those days, aeroplanes were huge and could move left, right, and backwards, unlike modern planes that only fly forward. Not only that, he claimed that the Vedic aircraft could also fly between planets! [3]

You might think that people would ignore such ridiculous claims. But no! In the webinar mentioned above held at IIT Kharagpur from 6 to 8 November 2020, the Union Education Minister Mr Pokhriyal announced the creation of a Centre of Excellence on Indian Knowledge Systems at IIT Kharagpur, and the Director Prof. Tiwari said the Centre would conduct research to find out “if the stories about Pushpak Vimana in the Vedic Age are really stories or if there is truth behind it” [1]. This Centre of Excellence has now published a calendar for the year 2022, which spells out what they mean by Indian Knowledge Systems.

In April 2018, the Tripura Chief Minister Mr Biplab Deb claimed that there was internet and television in the days of the Mahabharata: How else could Sanjaya give a running commentary of the war to the blind king, Dhritarashtra? [4]

In 2016, a workshop was organised at IIT Delhi to initiate research on the health benefits of ‘panchgavya’ [5]. In July 2019, the Uttarakhand Chief Minister Mr Triven-dra Singh Rawat claimed that the cow is the only animal that inhales and exhales oxygen [6]! As the COVID wave hit India in 2020, some quarters propagated the idea that drinking cow urine and dunking in cow dung would ward off the virus. Collective cow-urine drinking sessions were organised in many places!

In 2014, taking part in a Parliament debate, Mr Ramesh Pokhriyal ‘Nishank’ claimed that astrology is the biggest science, and modern science is a dwarf in front of astrology. “We speak about nuclear

science today, but Sage Kanad conducted nuclear test one lakh years ago”, he said [7]. Nishankji went on to become the Union Minister of Education and was instrumental in tabling the NEP-2020. Therefore, it was expected that his ideas would find a place in the education system. In June 2021, the Indira Gandhi National Open University announced that they are starting a new MA programme in Jyotish (astrology).

The list can go on and on. But we see that the proponents of IKS believe that in the ancient Vedic age, there were aeroplanes, the internet, stem-cell technology, plastic surgery that can place an animal’s head on a human torso, and so forth. This is what they plan to propagate through the education system.

Can the claims be true?

Isn’t it possible that the above were truly there in ancient India? I would request the readers to consider four issues and draw their own conclusions.

Firstly, these claims have always been made *after* modern science invented something. There have been no claims on ancient aircraft before the Wright Brothers invented the aeroplane and they came to common use. Nobody claimed that Sanjaya gave a running commentary of the Mahabharata war using internet live streaming before the internet was invented in the 1980s. Nobody talked about Karna’s birth as a result of stem cell technology before modern science started research on stem cells.

Secondly, if modern science and technology were truly there in ancient texts, one could have made inventions by following these texts. Not a single invention has happened that way.

Thirdly, any development of technology requires the prior development of basic sciences. Aircraft could be built only after

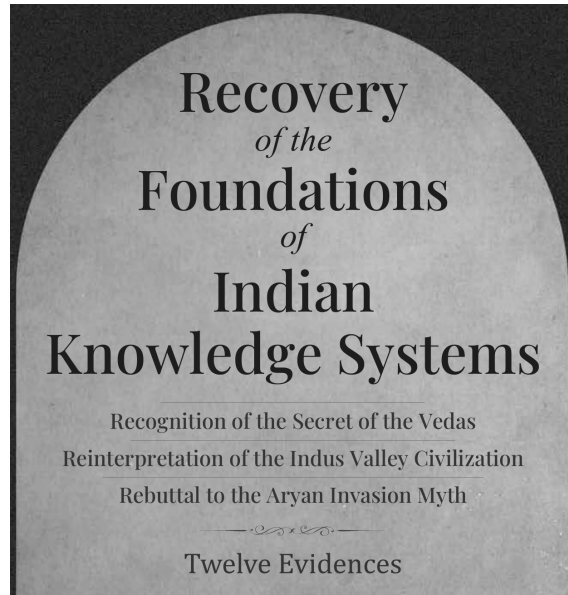
we acquired an adequate knowledge in aerodynamics, thermodynamics, engines, properties of materials, solid mechanics, navigational technologies, etc., and then combined these knowledges coming from different branches. In order to claim that there were aircraft in ancient India, one at least has to show that the laws of thermodynamics or Bernoulli's principle were known in that period. Internet could not have been invented before transistor switches, logic gates and digital technology were developed. That is why, to claim that there was internet in ancient India, one has to show that this knowledge existed in the first place. Apart from tall claims, no one bothers to back them with proof that such technologies existed back then.

Fourthly, no physical evidence of any such aeronautics technology has been found at any archaeological site. If aircraft really flew over the Vedic skies, some remnants should have been found in an archaeological site. If modern weapons were used in the Mahabharata war, some fragments should be found in the excavations in Kurukshetra. None has been found.

The 'Indian Knowledge Systems' calendar of IIT Kharagpur

IIT Kharagpur's 'Centre of Excellence for Indian Knowledge Systems' has published a 2022 calendar with the express purpose of promoting certain views. As stated at the outset, the purposes of this calendar are "recovery of the foundations of Indian Knowledge Systems, recognition of the secret of the Vedas, reinterpretation of the Indus Valley Civilization, and rebuttal to the Aryan invasion myth". More importantly, this calendar gives an insight into what the proponents of the IKS mean.

The storyline running through the calendar is an attempt to establish that Vedic



The front-page of the IIT Kharagpur calendar

India was the cradle of all civilisations worldwide. They had to extrapolate the Vedic period back in time by 10,000 years or more for that purpose. The thorn in this claim was that the timeline of the Harappan civilisation has been established scientifically by radiometric dating to be from about 7000 BCE to 1800 BCE (2600 BCE to 2000 BCE is considered the 'mature' phase). So, to push the Vedic culture's antiquity beyond this period, they had to establish that the Harappan civilisation was a part of the Vedic age, and the Harappan people were none other than the Vedic Aryans. That is why we see the claims that it must have taken 'a few 1000 years' to create the spiritual texts of the Vedas, that the image of a one-horned imaginary animal found in some Harappan seals was none other than the 'Ekashringa Rishi' mentioned in the Puranas, that the rivers Sindhu and Brahmaputra (and hence the Indus Valley and the Brahmaputra Valley civilisations) originate from Mount Kailash, that the

swastika symbol found in some Harappan seals was a Vedic icon, and so on.

It can be easily verified that the first two are wild claims, and the other two are factually incorrect. The Indus originates from the Bokhar Chu glacier located close to Mount Kailash, but the Brahmaputra originates from a different place: the Mansarovar lake region. The swastika symbol is found in practically all civilisations, including African, Native American, the Aztecs in South America, etc. (an internet search for 'Swastika' will yield a list, with pictures).

We could have ignored these claims as elements of personal belief. After all, a calendar is not considered a medium for disseminating serious, evidence-based studies and ideas, for which peer-reviewed scientific journals are more appropriate. However, we cannot ignore these ideas because we are staring at the possibility of these beliefs being introduced in schools and college curricula.

That is why we need to sift through the claims, assess them scientifically on the basis of verified historical facts.

Was the Harappan really a part of the Vedic Age?

According to most historians, the Harappan Civilization was a pre-Aryan civilisation. The Aryan-speaking people once entered India from the steppe highlands of Central Asia and gradually gave birth to a rich Vedic culture. The proponents of 'Indian Knowledge System' see it as a conspiracy of Western historians. So they want to rewrite history, and renaming is the first step. The recent history textbook brought out by the UGC calls the Harappan civilisation as the 'Saraswati Civilisation'.

When historians conclude something, they have to do it based on evidence. They have to present those evidence before sci-



A few typical Harappan seals showing animals and written text.

entists and historians by writing research papers. Others judge whether it is possible to draw that conclusion from what has been found. Only when recognised in this process, does it get a place as 'history'.

So, after the discovery of Harappa and Mohenjo-Daro in the early 1920s and subsequent finding of more than a hundred such ancient sites, what evidence was dug up that led historians to conclude that this civilisation was pre-Vedic? There are four pieces of evidence.

First, houses in the Harappan civilisation were made of burnt clay bricks. But for more than a thousand years after that, no brick house has been found on the Indian subcontinent. This implies that the Vedic Aryans did not make terracotta bricks, indicating that the Harappan Civilization could not have been part of the Vedic Age.

Second, the main animal in Vedic literature is the horse. But there has been no sign of horses in the wild in any forest on the Indian sub-continent. This means that horses came to India with men. Excava-

tions at hundreds of archaeological sites in the Harappan Civilization have uncovered many terracotta seals. These have pictures of various animals—bulls, tigers, rhinos, elephants, deer, pigs, and even a one-horned fictional animal with the body of a bull and the head of a deer. But there is no picture of a horse. In other words, the animal, the horse, could not have been there in the Harappan civilisation¹. That led historians to conclude that the horse came to the Indian subcontinent along with migrating humans from a place where there are wild horses.

Third, the Indus Valley Civilisation seals show that they had a written language. The writing has not yet been deciphered, as it bears no resemblance to any modern language. But it is certain that there was a written language. And we also know that in the early days of Vedic civilisation, the verses of the Vedas were propagated and preserved through *shruti* (what is said) and *smriti* (what is remembered). If the Harappan Civilization was to be a part of the Vedic culture, then the language of the Rigveda is supposed to be a continuation of the written language of the Indus Civilization, that is, there would be similarities between the two. That is not the case.

Fourth, nowhere in the Vedic literature like the Vedas, Vedanga, Vedanta, Upanishads, and Puranas is there any description of urban life like that found in the Indus civilisation: brick houses, paved roads, covered sewerage and drainage systems, public bath, elevated granaries, etc.

Based on these four clues, historians have concluded that there was no cultural connection between the Harappan Civilisation and the Vedic culture. Radiometric

¹Historians believe that horses had not arrived in large numbers in the Indian subcontinent during the Harappan period. However, the Harappan cities had trade links with Central and West Asian people, and it is likely that they may have come across the animal.

dating of the artefacts has shown that the Harappan cities were no longer inhabited from around 1800 BCE. Since there is an uninterrupted cultural history of the Vedic civilisation, historians concluded that the Vedic Age started only after the end of the Indus civilisation. The earliest horse fossils in the Indian subcontinent, found in the SWAT valley of Pakistan, and the history of the evolution of the Indo-Iranian language group (especially the striking similarity between the language and content of the Avesta and Rigveda), indicate the same timing of arrival of Aryan-speaking steppe people in India [8].

The strongest evidence of migration of the steppe population comes from genetic studies reported over the last five years. Earlier genetic studies had used a marker from the X-chromosome, which flows from mother to daughter, and these studies did not find evidence of the influx of new genes over the past 12,500 years. However, since 2016 many studies have been reported that used the haplogroup R1a found in the Y-chromosome (a haplogroup is a group of DNA sequences that share a common ancestor and hence can identify a line of descent). By sequencing the genes of 16,244 male subjects from 126 populations, a research paper reported that this haplogroup occurs in people living over a vast range in Europe, Central Asia and South Asia, including the Indian subcontinent [9]. Using modern techniques, it is possible to identify the region from which this specific genetic marker has radiated [10], and the study concluded that the focus is the Pontic-Caspian Steppe.

The fact that the evidence of large-scale migration is not found in studies that use chunks of the X-chromosome but does show up in the Y-chromosome studies implies a sex bias in the migrating population: the migrating people were predominantly

male. Today, about 17.5% of Indian male lineage has been found to belong to haplogroup R1a. Further investigation revealed two sub-haplogroups: the subgroup Z282 is distributed only in Europe (96% of the R1a samples in Europe belonged to this sub-group), while another subgroup, Z93, is distributed only in parts of Central Asia and South Asia (98.4% of the Central and South Asian R1a lineages belonged to this sub-haplogroup). The two groups diverged from each other only about 5,800 years ago [11].

Therefore, there is strong evidence of the male-dominated influx of the steppe population into the Indian subcontinent some 4,000 to 3,500 years ago [12]. Recent gene sequencing studies of the Indus people have found striking dissimilarity with the ancestral North Indian population. The study of DNA samples of the skeletons found in Rakhigarhi, an Indus Valley Civilisation site in Haryana, has found no traces of the R1a haplogroup that is related to the Central Asian 'steppe' people, which is found in much of the Indian population today [13].

The authors of the calendar seem to be declaring war on what they call the "Aryan Invasion Myth". This is like fighting an imaginary enemy since no historian today says there was an Aryan invasion—simply because there are no signs of destruction by war in the Indus cities. The correct understanding is that there was a migration of people from the Asian steppes, and the timing of that migration was after the city-based Harappan civilisation disintegrated probably due to natural causes like drought, disease or famine.

Human history is a history of migrations. Almost all humans on Earth today are descendants of people who migrated from central Africa roughly 75000 years ago. Since then, people have constantly moved

from one place to another, settled, and have mixed with the local populations. That is why the people of no place can be said to be belonging to a pure race.

What was the true knowledge system in India?

Like any other civilisation in the world, we also have a rich history of cultivating knowledge. The Harappan civilisation distinguished itself in terms of the technological development necessary for urbanisation: brick-built houses, the grid pattern of roads, drainage system, public bath and granary etc. After this urban civilisation disintegrated, the Vedic age started, characterised by a high standard of literature: the Vedas, Vedanga, Vedanta, Puranas, Upanishad, etc. We see some development in geometry in this period, as evidenced in the Sulvasutras.

The major advancements in ancient India happened in the post-Vedic or Siddhantic period. In medical science, we see the work of Susruta and Charaka. Panini formalised the Sanskrit grammar and gave it a formal structure to make it easier to learn. Kautilya made important contributions to the political organisation of society. Zero and the place value system of writing numbers were introduced in the 2nd-3rd century CE, after which mathematics advanced in leaps and bounds. Aryabhata, Varahamihira, Brahmagupta, Sridhara, Bhaskara-II and many other mathematicians made seminal contributions to arithmetic, algebra and trigonometry. Ideas in astronomy developed hand-in-hand with the advancements in mathematics. Alchemy developed in the hands of Nagarjuna and others. Important developments happened in metallurgy, and the 'wootz' steel technique was perfected in this land. For a long time, Indian kingdoms exported steel to the Middle-East, where it was in great demand. For details of the

scientific developments in this period, see [14].

However, after the 9th century, science in India declined, and after the 11th century, very little science was left. In the book "History of Hindu Chemistry" [15], Acharya P C Ray attributed the decline and fall of science in India to three causative factors:

1. Due to the ascent of a rigid caste system, the doers and the thinkers no longer exchanged knowledge and experience.
2. The do's and don'ts of the shastras (in particular, the Manu Samhita) made it impossible for practitioners of medicine and surgery to teach the next generation because dissection of dead bodies became impossible (only shudras were allowed to touch cadavers).
3. A large section of the intelligentsia became influenced by the 'maya' philosophy of Shankara, which saw the material world as an illusion. Naturally, they were no longer inclined to probe the character of the material world.

After the 11th century, the light of science was practically extinguished, and India plunged into a Dark Age.

The great contributions made in ancient India should make us proud. But instead of researching these, if we claim that in ancient India, there were aeroplanes, the internet, stem cell technology, plastic surgery which could plant an animal head on a human torso, etc., it would effectively undermine the value of these real contributions.

There is another aspect. Knowledge develops through a cumulative process of interacting with different civilisations and cultures. Knowledge cannot be termed as Indian, Egyptian, Chinese or any other. Humanity has reached the present stage

through the cumulative process of cultivation of knowledge, assimilating and improving upon the knowledge obtained from different lands. For example, Newtonian mechanics, which was a path-breaking achievement in the history of humankind, was the result of the knowledge accumulated till the time of Newton by the thinkers and philosophers of different lands. Newton's famous quote, "If I have seen further it is by standing on the shoulders of giants", is a testimony of this.

The knowledge created in ancient India has been subsumed in the wealth of knowledge created by humanity. It is now an integral part of the knowledge available everywhere.

Should we teach our students ancient knowledge?

As we have seen earlier, what they understand by Indian Knowledge Systems or Sanskrit Knowledge Systems are just matters of fanciful imagination based on a blind belief that all modern science and technology existed in ancient India. The real danger in this is that it could lead to the emergence of a generation of students steeped in such blind belief.

Such a deliberate design at adulteration of science education with such myths in the name of glorifying the past with false claims will not only discredit the actual achievements that were made in different branches of knowledge in those times, but have dire consequences on the development of scientific temper and critical thought among students in their most impressionable years.

But we have seen that there were commendable developments in ancient India, especially in the post-Vedic or Siddhantic period, in different areas of science and technology. Can we not teach that knowledge? Can we not teach algebra and

trigonometry from Brahmagupta's writings, spherical geometry and positional astronomy from Bhaskaracharya's books, medical science from Charaka Samhita, linguistics from Panini, or economics from Kautilya?

These works surely have a lot of historical significance, and any historian of science should take cognisance of them as important milestones in humanity's quest for knowledge. But man's understanding of nature and society has advanced significantly since their time. Science and technology are cumulative processes in which each generation builds on the knowledge created by the earlier generations, and at any point in time, humanity has the advantage of the knowledge accumulated by all past generations, including the ones developed during the Vedic period and later. That is why the most advanced knowledge in every field should be imparted to the upcoming generation.

Notice that even though Newton was responsible for creating much of classical mechanics, we do not use his *Principia Mathematica* to teach mechanics to our students. That is because knowledge in classical mechanics has advanced since Newton's time, and we impart the latest knowledge. We do not teach chemistry using Lavoisier's writings for that same reason, even though he was a father figure in modern chemistry. This is true in all fields of human knowledge.

Moreover, creating knowledge and imparting that knowledge to students are two different things. A book written for a learned audience may not be the right material as a class textbook. Pedagogy demands specific treatments to develop, step by step, an integrated understanding of a subject. This is another reason why we do not teach mechanics from Newton, chemistry from Lavoisier, and mathematics from Fermat or Euler. Teachers in later

periods have devised better methods of imparting the knowledge created by these stalwarts. These are the books used by universities worldwide.

The same concept applies to the works of ancient authors like Charaka, Aryabhata, Varahamihira, Brahmagupta and Bhaskaracharya. Science has progressed; some of their ideas have become integrated into the available body of knowledge, and some of their ideas have been proved wrong in the light of further research. Moreover, they mostly did not write with classroom teaching in mind, and so these texts are not suitable for that purpose.

In the days of Ishwar Chandra Vidyasagar (1820–1891), mathematics used to be taught using Bhaskaracharya's *Lilavati* and *Vijaganita*. Vidyasagar felt that this practice was depriving students of the taste of modern mathematics and was rendering students weak in the subject. So he introduced the teaching of mathematics from modern textbooks. He wrote in justification: "These two works are very meagre. . . . The examples are very few. The study of mathematics in Sanskrit should be discontinued. It is not to be understood from this that I undervalue a knowledge of Mathematics as an essential element of a complete education. Far from it. I wish to substitute the pursuit of it in English, whence in less than half the time now given to it an intelligent student will acquire more than double the amount of sound information that he could obtain by the most perfect acquaintance of all that exists in Sanskrit language in the subject."

Now the educational planners are claiming that the way forward is the stone wheel!

Pseudo-science in the name of Sanskrit Knowledge System

The NEP document also says, "In consonance with the rest of this policy, Sanskrit

Cover Article

Universities too will move towards becoming large multidisciplinary institutions of higher learning” (Article 22.15). Let us see what courses the Sanskrit universities are teaching now. The Kavikulaguru Kalidas Sanskrit University located in Nagpur is offering a BA course on Vedang Jyotish. Sri Lal Bahadur Shastri National Sanskrit University located in Delhi is teaching courses like Phalit Jyotish, Siddhant Jyotish, Vastushastra, etc. The Banaras Hindu University has an Astrology Department, which offers a two-year diploma course on Jyotish and Vastushastra.

The last issue of Breakthrough [16] had a very detailed exposition of astrology, and so we refrain from repeating it in this article. Suffice it to say that astrology and vastushastra are pseudo-sciences and should have no place in today’s school, college and university classrooms.

In conclusion

The New Education Policy 2020 seeks to introduce unscientific ideas and pseudo-science in the school and college curricula in the name of Indian Knowledge Systems. It is an attempt to change the narrative of Indian history and its intellectual contributions. The protagonists of this policy want to establish that Vedic India is the cradle of all civilizations. That explains their attempt to push back the Vedic period by 10000 years or more.

The science-loving people in general and the scientific community in particular should launch a movement to save the education system from this attack. □

References:

1. The recording of the session can be found by searching YouTube with the keywords: ‘Bharata-Tirtha’ An International Webinar on Indian Knowledge Systems (IKS) – Day 1 (1st half)
2. The Guardian, 28 October 2014.
3. India Today, 6 January 2015.
4. Deccan Herald, 18 April 2018
5. India Today, 18 February, 2017
6. Indian Express, 28 July 2019
7. The Hindu, 4 December, 2014.
8. David W. Anthony and Don Ringe, The Indo-European Homeland from Linguistic and Archaeological Perspectives, Annual Review of Linguistics, 1:199-219, 2015
9. Poznik, G., Xue, Y., Mendez, F. et al. Punctuated bursts in human male demography inferred from 1,244 worldwide Y-chromosome sequences. Nature Genetics 48, 593–599 (2016).
10. Partha P. Majumder, Understanding the Aryan debate: population genetic concepts and frameworks, Current Science, 114 (5), 971–975 (2018).
11. Silva, M., Oliveira, M., Vieira, D. et al. A genetic chronology for the Indian Subcontinent points to heavily sex-biased dispersals. BMC Evolutionary Biology 17, 88 (2017).
12. Vagheesh M. Narasimhan et al. (118 authors), The formation of human populations in South and Central Asia, Science, 365 (6457), (2019)
13. Vasant Shinde et al., An Ancient Harappan Genome Lacks Ancestry from Steppe Pastoralists or Iranian Farmers, Cell, 179 (3), 729-735, (2019)
14. Science in Ancient India: Reality versus Myth, Breakthrough Science Society publication, 2016.
15. Acharya P C Ray, History of Hindu Chemistry, Indian Chemical Society, 1956; and Cosmo Publications, 2010.
16. Articles by J V Narlikar, Partha P Majumder, Sunil Mukhi, and Aniket Sule, Breakthrough, Vol.22, No.2, September 2021.