Indian Journal of History of Science, 51.1 (2016) 1-7 DOI: 10.16943/ijhs/2016/v51i1/48371

Editorial

Tradition and Methodology of Knowledge Production

Indian Journal of History of Science (*IJHS*) has been publishing thematic issues from time to time. However, this thematic issue is of different order, topics being 'Knowledge Production in Pre-colonial India— Methodological Aspects'. This is an outcome of a seminar presentations duly revised and refereed as per norms of *IJHS*. The seminar was organized by Professor Rajan Gurukkal, the Guest Editor, on behalf of the Centre of Contemporary Studies (IISc, Bangalore) and sponsored by other organizations. The seminar has a wider connotation conceptually and methodologically irrespective of the knowledge in history and philosophy of science. The knowledge production is a sociological term introduced after the industrial revolution in Europe and known subsequently in other parts of the world. It is mostly context-driven, problem focused, and interdisciplinary in character on which the work is organized for a fixed period. The knowledge production in the Pre-colonial phase in India, on the other hand, was indeed a slow process based on traditions: oral, textual, commentaries (*guru-śiṣya paramparā*, teacher-student following), experiences of the working class subdivided into castes, and other groups. Despite social barrier of hand and brain coordination, India in the pre-colonial phase generated knowledge in metaphysics, philosophy, medicine, alchemy, mathematics, astronomy, metals & metallurgy, and other areas, sometimes germinated or resuscitated with other thoughts and actions and with movement of people, trade and commerce. How can the knowledge flourish without any conceptual or methodological connections?

In early phase in India, the *Upaniṣads* first recognized that the knowledge is of two types. These are: *Parāvidyā* (knowledge of Self and Infinite, *brahman-ātman*) and *Aparāvidyā* (all other types of knowledge).The former is considered as higher knowledge and latter as lower. The *Mundaka Upaniṣad* (i, 1. 4-5) has included *Ṛgveda, Yajurveda, Sāmaveda, Atharvaveda* , and the knowledge of *śikṣā* (phonetics), *kalpa* (rituals), *vyākaraṇa* (grammar), *nirukta* (etymology), *chandas* (metrics) & *jyautiṣa* (astronomy) under the category of lower knowledge. The *Bṛhadāraṇyaka Upaniṣad* (VII, 1.1) reiterates the same point with some elaboration in the dialogue of Nārada with Sanatkumāra. In this context, Sanatkumāra emphasized

> 'That, verily, which is Infinite is bliss;
> there is no bliss in what is small (*alpa*)'.

Aparāvidyā, however, is served as the training ground for *Parāvidyā*. Apart from six categories of knowledge from *śikṣā* to *jyautiṣa* under *Aparāvidyā* , four supplementary disciplines along with some additional ones , viz: *mīmāmsā* (exegetics), *nyāya* (logic), *purāṇa* (legendary lore), *dharmaśāstras* (ethics), *śulbasūtras* (rules for the construction of altars), *āyurveda* (medical science), *dhanurveda* (military science), *gāndharva-veda* (music and other fine arts) and *arthaśāstra* (polity) were also recognized under this category. The *Aparāvidyās* generally are of eighteen types which covered the major branches of knowledge including arts.

Pāṇini had direct concern for grammar with the form of language and accepted metaphysical concepts and presuppositions found in the *Upaniṣads*. Some of these are made explicit by Patanjali in his *Mahābhāṣya*. Pāṇini held that word are eternal, and the spoken words are to be distinguished from the real words, the former being transitory and non-bearer of meaning, while latter are eternal and meaningful. In fact, the division of words into letters, and of sentences into words, is only a matter of convenience. The grammatical

tradition of Pāṇini as regards structure, composition and linguistic features has influenced later grammatical traditions. The ancient Greeks developed logic and a notion of deductive rationality based on Euclid's geometry. According to Frits Staal, a well- known historian of science [Lecture on Concept of Science in Europe and Asia at the International Institute of Asian Studies ,1993] says,

> 'Pāṇini developed Sanskrit grammar as a derivational system in some respects more sophisticated than the deductive system of Euclid'.

The six orthodox system of philosophy (having allegiance to Vedas): *Nyāya*, *Vaiśeṣika*, *Sāmkhya*, *Yoga*, *Mimāmsā* and *Vedānta* have also contributed considerably to our knowledge system. *Nyāya* is a discipline in logic and epistemology, which stressed on valid knowledge by means of inference (*anumāna*), and three other *pramāṇas* like perception (*pratyakṣa*), analogy (*upamāna*) and testimony (*śabda*). To these two more were added by other schools: presumption (*arthśpatti*) in *Mimāmsā* of Prabhākara and Bhāṭṭa, and non-cognition (*anupalabdhi*) of Bhāṭṭa. The *Vaśesika* system of categories and atomism are speculative theories and not a measure of hypothesis based on experimental evidence. The concept of cause and effect has been dealt in *Vaiśesika* and *Sāmkhya*, and the principle of evolution has been detailed by *Sāmkhya* based on this principle. *Yoga* provides the technique of mind –control designed to effect the liberation of souls. In this context *Yoga* gives a penetrating analysis of mind and its functions which will be found helpful even by modern psychologist. *Advaita Vedānta* deals with *Parā-vidyā* and is not concerned with metaphysics of science. Max Muller [*Six System of Indian Philosophy*, London, 1916, Introduction, p. xi], writing on the six systems of Indian philosophy opines,

> 'What I admire in the Indian philosophies is that they never try to deceive us with their principles and consequences of their theories…. They are bona fide idealists or materialists, monists, or dualists, theists or atheists, because their reverence for truth is stronger than reverence for anything else'.

B. N. Seal [*Positive Science of the Ancient Hindus*, London; Reprinted, New Delhi, 1958] said,

> 'The ultimate criteria of truth is found not in mere cognitive presentation, but in the correspondence between the cognitive and practical activity of the Self, which together are supposed to form the circuit of consciousness. The knowledge is valid which prompts an activity ending in fruition (*pravṛtti-samarthyāt arthavat pramāṇam*—Vātsyāyana).

The three principal unorthodox system of philosophy: Buddhism, Jainism, and the Lokāyata, rejected the authority of Vedas as the valid source of knowledge and emphasized the testimony of human experience and reason. Buddhist sects (represented by Dignāga and his followers) took a positive interest in logic and scientific method, though for this purpose they had to suspend, as it were, the enthusiasm for extreme subjective idealism. *Karma* theory plays a role of immense importance in Jaina cosmology. According to Jaina philosophy, *Karma* is said to be the first and ultimate cause of the universe. It is due to *Karma* that the universe keeps on going. All changes, all manifestations, all phenomena are due to *Karma*. Jacobi has aptly described *Karma* to be 'the keystone of the Jaina system' (*Encyclopaedia of Religion and Ethics*, VII, p.469). *Lokāyata* put an uncompromising emphasis on direct observation as the primary way of knowing. This created a position having obvious difficulties for the philosophers who believed in the validity of worldly or normal inference which was based on perception. The intellectuals were essentially philosophers and scholars, the progress of scientific thought and knowledge was obviously limited.

The subsequent period witnessed the growth on a specified methodology, and development came in many branches of science. I will take only a few areas— medicine, alchemy & iatrochemistry, mathematics & astronomy, which produced a large number of manuscripts, attained the status of prestige

discipline and knowledge through textual tradition of *vyākhyā* or commentaries and original works.

In medicine (Āyurveda), following tradition of scholars and works are well known:

> Caraka (*Saṃhitā*) → Suśruta (*Saṃhitā*) → Vāgbhaṭa (*Aṣṭāngasamgraha, Astāngahṛdaya, Rasaratnasamuccaya*) → Bhela, Kāśyapa & Hārita (*Saṃhitā*) → Mādhavakara (*Nidāna* and *Cikitsā*) → Śārangadhara (*Saṃhitā*) → Cakrapāṇidatta (*Cakradatta*) → Bhāvamiśra (*Bhāvaprakāśa* and others along with their commentaries.

Both Caraka and Suśruta refer to earlier traditions, deal with philosophical ideas, metaphysical speculations & understandings and stressed on holistic concept of body and mind. The connection of the body, the senses, the mind, good works and the confidence on self are recognized, and the life *jiva–prakāśa* is said to rest on all of them. Diseases are manifestations of humoural imbalance which have to be tackled comprehensively on the psychosomatic basis. Health, accordingly, is the equilibrium maintained on physical, mental and spiritual levels.The doctrines of the *guṇas—sattva, rajas* and *tamas* is employed for explaining the evolution of things and experiences of individuals. Beside philosophical disciplines of logic and ethics, the medical schools have also laid down principles of valid reasoning, even correct modes of disputation. The doctrine of *karma* is adapted in such a way that the use of medicines in the cure of diseases becomes meaningful. Both Caraka and Suśruta recommended ethics for doctors and discussed the logical categories and insisted that every student of medicine should master them. The *Suśruta Saṃhitā* declares that the rules of reasoning illumine the subject of discourse, even as the Sun makes the lotuses bloom as the lamp imparts light to a house. Suśruta recommended eight divisions of medicine : surgery (*Śalya*), treatment of diseases of eye, ear, nose, mouth etc (*Śālakya*), general medicine (*Kāyācikitsā*), treatment of child (*Kaumārabhṛtya*), toxicology (*Agadatantra*), treatment for pacifying symptoms afflicted with gods, demons (*Bhūtavidyā*), prevention of ageing, promotion of life-span, intellect, strength and alleviation of disorders (*Rasāyanatantra*), and removal of the defects of semen and sexual stimulation (*Vājīkaraṇatantra*). These branches as a system of medical knowledge originated in north India, became popular in the south, specially Kerala and other areas. *Vājīkaraṇatantra* was replaced by *Pañcakarma* in Kerala tradition. *Rājanighaṇṭu* includes *Davyavidhāna* (XX.40) in place of *Rasāyana* in the eight disciplines of knowledge. Caraka, Mādhavakara, and Śārangadhara emphasized three techniques—diagnosis, prognosis and therapy for treatment of diseases. The diagnosis depends on the observation of physical features like, pulse (*nāḍī*), urine (*mūtra*), stool (*mala*), eye (*netra*), taste in mouth (*āsya*), tongue (*jīhvā*), voice (*śabda*) etc , and it is one of the five diagnostic methods coming down from Mādhavakara. Prognosis depends on seven factors relating patient's age, life, livelihood, astrological analysis etc. Therapeutic methods are of three types—general, preventive therapy—*rasāyana* & *yoga*, and curative—medicine & surgery inclusive of proper diet and correct conduct. The plastic surgery was also known to be popular in south India, though the technique of anesthesia is not clearly known. The travel account of Manucci suggests that he has seen many people with such noses (Storia, II, p.282). Variolation (*ṭīkā*), an inoculation of a healthy individual against smallpox, was also practiced by *Vaidyas* in Bengal, giving immunity to individual, as reported by Holwell [Dharampal (ed.), *Indian Science and Technology*, Delhi, 1983, pp.201-204]. The universities of Taxila (during Buddha's time, experts being Jivaka, Ātreya), Kāśī (having expertise in Āyurveda & surgery), Nālandā (medicine as compulsory discipline), Vikramśīlā (flourished under Pāla kings) achieved as centres of medical learning for their methodological approaches which attracted foreign students. Siddha medicine of south India is known for their preoccupation with medicine and alchemy, and is attributed to their quest for perfect health and immortality, as is common to all Siddhayogas. The medieval scholar, 'Abdul Qadir Badauni, a famous historian and critic of Akbar's reign in the 16th

century provided a code of ethics for physicians [*Nijāt ur-Rashid*, vide History of Technology, II, p.877] , which says,

> 'Any one who has not read the books of medicine with reputed physicians for number of years, not put them to use for long years of life, nor obtained knowledge of the properties of drugs , nor received authorization for medical practice from masters (in the profession) but simply wishes that by force of some institution, he may treat people without having any experience and consider it the means of gaining proximity to rulers and kings, is not a physician, no expert master, but a blood- shedder like a crude executioner'.

In fact, physicians were completely dependent on royal patronage, or on endowments from aristocracy, as reported by Bernier in his travel account, though there are references to private practitioners (quacks). Bernier further reports that in Mughal India, physician's profession, like all other profession, was hereditary in character and medicines prepared by them was mostly a secret [*Travels*, p.259].

In alchemy & iatrochemistry (*Rasaśāstra*), the interest centered round worship of Śiva and Pārvati by the tantric cult in India to fulfill their psycho-somatic experimental goals. This came into vogue after the decline of Buddhism. The *Mātṛkābheda tantra, Kubjikā tantra,, Rudrayāmala tantra* and others are the principal texts of this tradition. Their emphasis was on transmutation processes for changing baser metals into gold and silver with the help of mercury for rejuvenation and vitality. The preparation of mercury and mercury compounds are generally categorized *rasaśāstra*. The textual tradition of scholars and works in *rasaśāstra* (8^{th} to 15^{th} century AD) is well known:

> Nāgārjuna (*Rasaratnākara, Yogaśataka*) → *Rasaendra Maṅgala* → *Rasārṇava* → *Sarveśvararasāyana* → *Dhātuvāda* → Bhikṣu Govinda (*Rasahṛdaya*) → *Rasaratnākara* → Ācārya Somadeva (*Rasendracūdāmani*) → Rāmacandra (*Rasapradīpa*) → Yaśodhara (*Rasaprakāśasudhākara*) → Madana Deva (*Rasacintāmani*) → Rasaprakāśa Sudhākara → Vāgbhaṭa (*Rasaratnasamuccaya)* → Nityanātha (*Rasaratnākara*) and so on.

The alchemical and iarto-chemical traditions came into practice initially in connection with search and preparation of herbal medicine and subsequently fixation of gold, mercury and mercury compound as drugs for rejuvenation and longevity through the process of transmutation (of base metals into gold and silver). So various metals - gold and silver, amalgam of silver, copper, lead, zinc, bell metal (alloy of copper & tin) come into play along with alchemical processes like extraction of zinc, purification of mercury and copper, preparation of red sulphide of mercury, a medicament still used by the physicians as a panacea for almost all diseases. The texts also contain names of more than two dozen varieties of apparatus (*yantras*) for carrying out various physio-chemical processes like distillation, sublimation, extraction, calcinations, digestion,, evaporation, filtration, fumigation, fusion, pulverization, preparation of metals and metallic compounds, heating by steam, heating by sand etc for preparation of drugs. P.C.Ray [Autobiography, p.132] quotes Ramachandra and Yaśodhara to emphasize on the experiments and observation, and added:

> 'Experiments and observations constitute the fundamental bases of sciences'.

Production of zinc by tilted distillation (*tiryak pātana*) and zinc ores (*rasakas, kharpat*) in the *Rasaratnākara* remind us the earliest zinc distillation technique at Zawar region in Rajasthan.

The knowledge of mathematics and astronomy (*gaṇita / jyautiṣa*) in Vedic tradition originated mainly with the performance of the sacrifices through recitation and construction of altars for worship having fixed areas of different geometrical shapes on a specified time. The word-numerals and decimal scale were known which went up to 10^{12} and even 10^{18}. These decimal word-numerals, based on a strict methodological frame work, ultimately encouraged the origin of nine

decimal place-value symbols and zero, which is recognized universally as one of the finest discovery of the Indians. Other types of numerical system like *bhūtasankhyā, kaṭapayādi,* etc based on decimal place-value were also introduced in later phases to avoid numerical variation in regional uses and suit the metrics in verse-format in Indian tradition. The construction of altars of various shapes having the same size led the basis to make the general statement of the square on the diagonal of a right triangle ($a^2 + b^2 = c^2$), to calculate the value of the diagonal of a square or the value of $\sqrt{2}$ (correct to five places of decimals with stipulation that it is even approximate) in the *Śulba-sūtras*, and so on. These are some of the examples of high precision achieved on the basis of set criteria and methodology . The Vedic and post-Vedic tradition recognized also the five elements of calendar to regulate their life and time of worship. These are : *tithi* (lunar day or relative motion of moon w. r. t. sun, 12°), *karaṇa* (half-tithi, 6°), *nakṣatra* (space = 13° or 800 minutes; occupied by planet $= \frac{\lambda_p}{800}$, where λ_p = longitude of planet reduced to minutes), *yoga* (obtained by $\frac{\lambda_s + \lambda_m}{800}$ the longitudes of sun and moon reduced to minutes), *vāra* (name of the week day).

The Siddhāntic and Kerala traditions made a great names in the standardization of knowledge. The major scholars & works are:

Siddhāntic (476-1350) : Āryabhaṭa I (*Āryabhaṭīyam, Āryasiddhānta*) → Varāhamihira (*Pañcasiddhāntikā, Bṛhatsaṃhitā*) → Bhāskara I (*Mahābhāskariyam, Laghubhāskarīyam, Āryabhaṭīyabhāṣya*) → Brahmagupta (*Brāhmasphuṭasiddhānta, Khaṇḍakhādyaka*) → *Sūryasiddhānta* → Mahāvīra (*Gaṇitasārasamgraha*) → Lalla (*Śiṣyadhivṛddhidatantra*) → Śridhara (*Pātīgaṇita*) → Śrīpati (*Siddhāntaśekhara*) → Bhāskara II (*Līlāvatī, Bījagaṇita, Siddhāntaśiromaṇi, Karaṇakutūhala*) → Nārāyaṇa Pandita (*Gaṇitakaumudī, Bījagaṇitavatamśa*) → Gaṇeśa Daivajṇa (commentaries on Bhāskara II's works—*Buddhivilāsinī* or *Līlāvatīvyākhyā*, *Siddhāntaśiromani-vyākhyā*, *Grahalāghava, Laghucintā-mani, Pratodayayantra* and others) and a large number of commentaries on each of these works played a very important role on a well defined methodology.

Keraliya (1350- 1650): Mādhava (*Venvāroha*) → Parameśvara (17 commentaries on earlier works of Āryabhaṭa, Bhāskara I, Munjāla, Sūrya, Bhāskara II & others, and 7 original works like *Dṛggaṇita, Goladīpikā I & II, Grahanamaṇḍana, Parahitagaṇita, Grahana-nyāya-dīpikā, Vākyakaraṇa*) → Nīlakantha (11 works of which 4 commentaries are on the works of Āryabhaṭa I, *Candrachāyāganita* & others, original works are : *Golasāra*, *Siddhāntadarpaṇa*, *Tantrasangraha*, *Grahanirṇaya*, *Jyotirmīmāmsā*, etc) → Śankara Vāriyar (*Kriyākramakarī* comm on *Līlāvatī, Yuktidīpikā* comm on *Tantrasangraha*) → Jeṣṭhadeva (*Yuktibhāṣā*) and others.

Instruments & Numerical tables (1350-1750): Mahādeva (→ Padmanābha → Makaranda → Keśava II → Gaṇeśa Daivajṇa) → Nityananda → Jayasimha → Jaggannatha Pandita and others.

The Siddhāntic scholars in arithmetic, made all round effort to standardize the knowledge on eight fundamental operations (addition, subtraction, multiplication, division, square, square-root, cube, cube-root) based on decimal place-value . The operations were carried out on board (*pāṭī* with chalk) along with other operations like rule of three, fractions.. In algebra, Brahmagupta (c. 628 AD) emphasized (*BSS*, xviii.2) that the expert *ācāryas* were deft in the operations of zero (*śūnya*), negative and positive quantities (*ṛṇa-dhana*), unknown quantities (*avakta*), elimination of middle term (*madhya-haraṇa*), equations involving products of unknown (*bhāvanā*), and also solutions of first degree indeterminate (*kuṭṭaka*), and second degree equations (*varga-prakrti*). In geometry, quadrature problem and properties of right triangles together with the application of plane and spherical trigonometrical methods and iterative processes were

used as adjunct to in astronomy. The knowledge system in astronomy proper dealt with major divisions of finding of mean longitude of planets; true celestial longitude ; computing the apparent direction, place and time of celestial phenomena as seen from terrestrial location; calculation of lunar eclipses (*candragrahaṇa*); calculation of solar eclipses (*sūryagrahaṇa*) etc. The potential sources of information on traditional proofs, rationales, derivations and demonstrations are commentaries on the basic texts. In earlier works, most commentaries restrict themselves to the explanation of words of the texts and do not go further. There are certain commentaries which elucidate rationales, partly or fully. Rules are exemplified with examples. There are other type of texts based on earlier siddhāntic texts, which introduce revisions, innovations and methodologies, all aimed at arriving at better and more accurate results.

The Kerala scholars starting from Mādhava onwards concentrated on the quadrature problem fixing the value of π (correct to 10 places of decimals), imposed corrections to infinite series, expressed Sine and Cosine into power series for better results which are unique by contemporary standard. Nīlakaṇṭha, in his commentary (*Āryabhaṭīyabhāṣya*), pointed out that Āryabhaṭa I intended astronomy to be a practical discipline, his method in *Golapāda* recommended the verification and revision of his own astronomical constants by observation (*TSS* No. 185, Trivandrum, 1957,pp.1-2). Parameśvara reiterated that he perfected the results of parameters after 55 years' of research, so that the results accord with more or less actual observation (*Grahana-nyāya-dīpikā*, ed K.V. Sarma, Introduction, pp. xiv-xviii). He observed that Varāhamihira's method (*Bṛhatsaṃhitā*, V.25) of prediction of eclipses occurs outside their calculated time during his time. He therefore improvized correction to be applied for mean position of Sun, Moon, Apsis and Node which is given in his work, *Grahanamandana*. This he has recorded at the close of his *Dṛgganita*. Nīlakaṇṭha, Śankara Vāriyar, Jeṣṭhadeva other Kerala astronomers stressed on the importance of observations in a similar fashion. Bhāskara II, and some of these later works include rationale and elucidation in a manner a teacher does to his student. To quote Nīlakaṇṭha (*Jyotirmīmāmsā*, ed by K.V. Sarma, VVRI, 1977, p.6):

> 'Five *siddhāntas* had been authoritative at one time (but not now).Therefore one has to look for a *pramāṇa* which tallies with the observation. …Experiments have to be conducted with instruments,…and a new system has to be expounded'.

A few portable, small size Sanskrit instruments were of course traditionally known. These were measuring instruments like— water clock [*nādikā yantra, ghaṭikā yantra*], amplitude (*agrā*) of the sun at sunrise or sunset by the shadow of gnomon falling on the circle [*śanku*], hemispherical sundial [*kapāla yantra*], equinoctial sundial [*nādīvalaya, phalaka yantra, kartarī yantra*], whip-shapped gnomon [*pratoda yantra*], astrolabe [*yantrarāja*] quadrant [*turīya yantra*], armillary sphere [*golānanda*], etc for time and coordinate measurements. Mahendra Suri and Malayendu Suri during Firuz Shah dynasty (1351-1388) took interest on astrolabe—its construction and use, was greatly inspired and composed works.

Sanskrit numerical tables focused mainly on planetary revolutions, sine difference & sine tables, *paṇcānga* elements, eclipse data etc [*IJHS* 49.2 (2014)]. The Islamic *Zij* of Central Asia which infiltrated during the Mughal period [mid-16th century] are essentially astronomical numerical tables to measure time, and helpful for computing planetary and stellar positions, appearance of the moon, and eclipses. A number of *Zijes*, prepared under the patronage of the rulers, did not of course incorporate any new observations but were updated versions of *Ulugh Begī Zij*, a copy of which is still available in Sawai Jai Singh's library. Jai Singh of Amber in Rajasthan, the statesman astronomer, who was possibly impressed by the models of stone observatories in Maragha (built by Hulagu Khan, 1259) and Samarkand (founded by Ulugh Beg, 1424), decided to build up stone observatories in India with encouragement and patronage of Mughal and regional rulers. Five observatories were built

between 1718 to 1730 in Delhi (fitted with 7 instruments) , Jaipur (two sites, site I : 8 instruments as per first map, 15 instruments as per 2nd map, however present observatory has 16 masonry and 6 metallic instruments; site II : 8 instruments appears to have been added later), Ujjain (7 instruments) , Varanasi (10 instruments) and Mathura (4 instruments) These precision instruments helped to find the horizontal coordinates (azimuth & altitude), equatorial (hour angle & declination), ecliptic coordinates (longitude &latitude), solar & transit times besides other elements, and were so designed that the measurement of time and angle may be limited to naked eye observations. Jai Singh composed a *Zij*, universal sundial (*Yantrarāja*), lunar table (*Drkpaksasāriṇī*), and sent also a fact-finding scientific mission to Europe lasting for four years (1727-1731) in order to improve his tables. He encouraged Jagannatha, an expert in Sanskrit and Arabic, to translate Euclid's *Elements* and Ptolemy's work on *Almagest* into Sanskrit from Arabic. Telescope was found in the holdings of Jai Singh but it could not be profitably used because of chromatic aberration in lenses.

In fine, it may be said that the three classical languages—Sanskrit, Persian & Arabic remained the vehicle of knowledge production in the pre-colonial phase. While the tradition and production system is distinct and clear in Sanskrit, it is not so in Persian and Arabic. A large chunk of the people in the medieval phase specially craftsmen did not have any exposure because of non- use of prose literature & printing press for development of vernacular languages (Hindi, Bengali, Urdu etc) and absence of any dialogue or theoretical education for them. Moreover, rivalry, secrecy, social taboos, religious barrier on society and education hampered the production system. However, the 'uniqueness' is found in medieval architecture like *Taj Mahal*, etc. All aspects of human knowledge are actually involved in complicated interactions within our changing society. It is difficult to separate arts from technology or either from science. Early forms of knowledge were both essential and rewarding to individual and development of society at large. Knowledge invariably grows either with the tradition or with movement of the scholars having new ideas and knowledge, having more or less a clear methodology or a pattern of holistic interaction in an open society. The role of schools, universities and teachers may be stressed as important element in the production of knowledge system. The importance of institutionalized efforts in Indian society was not rightly appreciated, as it was done in the establishment of Royal Societies in England and France. Even then, the tradition of wisdom in India did a marvelous job when the knowledge system passed down from teacher to his pupil, at times his own son or close relative as his pupil. The teacher—student relationship is the embodiment of truth and brought refinement to knowledge and knowledge production. This relationship may seem a more fragile way than written records, but in reality it has been proved more durable, and the living links are forged generations after generations.

We are indeed thankful to the Guest Editor for his excellent cooperation and to all contributors and reviewers for making this issue so exciting.

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