

An Ayurvedic view of life*

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Ayurveda, according to Caraka, is knowledge which seeks to weigh life in the scales of wholesomeness and happiness against their opposites. Its main themes of health and disease, and recovery of health from disease take the stage against an inspiring background of intuitive philosophy, lofty idealism, and vivid compassion, which are the hallmarks of India's cultural inheritance. After centuries of neglect and stagnation, Ayurveda has witnessed an unprecedented resurgence from the twentieth century in India and abroad. Ayurveda viewed health as a state of many-sided equilibrium, and disease as its reversal. Ayurvedic practice of medicine aimed at the restoration of equilibrium and, in that process, represented more than the sum of dietary regimen, procedures and medications.

Keywords: Ayurveda, diseases, dynamic virtuous life, equilibrium.

From thrombosis to Ayurveda

IT is an eloquent commentary of our times that this lecture is sponsored by the Thrombosis Research Institute, which does advanced research on thrombotic disorders in its centres at London and Bangalore. Thrombosis is a reversal of the natural state of the blood which remains liquid in the heart and blood vessels thanks to a state of equilibrium between blood and its conduits – what is technically called ‘vascular homeostasis’. It occurs when the equilibrium breaks down and blood solidifies in blood vessels during life to the detriment of organs or life itself. Triggered by many causes, thrombosis progresses through a biochemical cascade of great complexity. This intricate event evolved over millions of years when organisms with a closed vascular system had to seal any breaches in the vascular compartment to prevent exsanguination by forming a plug or coagulum without causing generalized thrombosis. When the vascular system was open in primitive organisms earlier (e.g. Crustacea), coagulation provided a defence against invading microbes. In recent years, studies on the molecular evolution of coagulation factors and complement system have shown that both processes arose from a single ancestral mechanism which provided defence against microorganisms and against the loss of body fluids. Determination of the coding sequence of coagulation proteins from many species has even allowed an estimation of the order of appearance of coagulation proteins in the evolution of species. The ongoing work to prevent deep vein thrombosis and

thrombo-embolic complications of prosthetic heart valves is beneficial and life-saving, but it can have few claims to impinge on the biology of coagulation which will possibly continue to evolve as man finds new habitats with vastly different living conditions. Above all, the breakdown of equilibrium as the trigger for thrombosis has a strong resonance in Ayurveda which postulated a different kind of equilibrium – *sāmya* – as the basis of health and its disturbance as the equivalent of disease.

Ayurveda – early history

Caraka said that the science of life always existed, and a beginning can be said to have occurred only with reference to the first attempt to put down concepts and practice in writing. The earliest record of the roots of Ayurveda is found in the *Atharvaveda* (circa 1500 BC), which has numerous hymns relating to health, diseases, fertility, herbal drugs and anatomy. No wonder Caraka insisted that students of Ayurveda should be loyal to the *Atharvaveda*, which regarded diseases as the punishment of gods for human transgressions. The Atharvan practice of medicine was driven by faith – *daivavyapāśraya*. The Buddhist phase which followed marked a sharp decline in the use of hymns, but Ayurvedic concepts and practice flourished as shown by numerous textual references in the Buddhist period, such as *Milindapanho*, *Dīkhanikāya* of Suttapitaka, *Mahāvagga* of Vinayapitaka and *Visuddhimagga*. The universities of Takṣaśīla and Nalanda became famous for medical studies and attracted students from many other countries in Asia. The practice of medicine was driven by empiricism, not faith, in Buddhist India. The next phase was heralded by Caraka's redaction of *Agniveśa Tantra* (1st century) when intellectual life in India was in ferment. The six systems of Indian philosophy were differentiating

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at this time from pre-existing but undifferentiated strands of the *Upanisads*, and they were often in conflict with Buddhist doctrines. The vigorous intellectual climate influenced Caraka, whose *Samhita* stood out for its philosophical bias. It became the foundational text of Ayurveda, used even today by the students and practitioners of Ayurveda, and marked a shift of Ayurveda from faith-based to reason-based (*yuktivyapāśraya*) practice. The redaction of *Suśruta Samhita*, which was done by Nāgārjuna a few centuries after Caraka, became another classical text widely admired for its surgical orientation and descriptions of operations and instruments. The last of the 'Great Three' of Ayurveda was Vāgbhaṭa, who probably lived in the 6th century and composed *Aṣṭāṅga samgraha* and *Aṣṭāṅga hr̥daya*. The *Samhita* phase of the 'Great Three' was the golden age of Ayurveda, which was systematized and taught and practised all over India. As the *Samhitas* were translated into Arabic and Tibetan, and texts such as the *Bower Manuscript* were discovered in Central Asia, it is clear that the reach of Ayurveda extended far beyond the Indian sub-continent.

Stagnation and resurgence of Ayurveda

The golden age of Ayurveda was over after Vāgbhaṭa. The period of stagnation which followed lasted a thousand years when advances became a trickle, such as the advent of counting pulse, use of mercury and opium in treatment and the description of syphilis. But there were no more Carakas or Suśrutas and no more Takṣaśilas or Nalandas. The surgical procedures of Suśruta disappeared from the mainstream of Ayurveda and survived precariously among the 'lower castes' here and there. Surgical operations such as the plastic repair of the nose, couching for cataract, complicated deliveries, setting of fractures and many other procedures were not done by traditional Vaidyas, but by illiterate practitioners who passed on their manual skill from one generation to the next. According to P. C. Ray, India's soil at this time was made 'morally unfit for the birth of a Boyle, Descartes, or a Newton, and her very name was all but expunged from the scientific world for a time'. India's East-West encounter in the 19th century spurred the growth of modern science and medicine and brought about a revolution in India's cultural history. Unfortunately the encounter spared Ayurveda, which suffered from neglect if not denigration. Ramnath Chopra's brilliant contributions on the pharmacology of natural products of Ayurvedic origin, commercial production of Ayurvedic drugs by P. S. Varrier at Kottakkal, Gananatha Sen's work in Calcutta and Lakshmiopathy's in Madras were a few lamps which shined in a sea of darkness. A dramatic resurgence came after Independence and Ayurveda has never had it so good as in the 21st century. In the growth of patient care, education, research, com-

mercial production of drugs, and patronage by the Government, the position enjoyed by Ayurveda is enviable today.

The Ayurvedic canvas

Ayurveda, in the literal sense, is the knowledge of life. P. C. Ray characterized the long phase of India's cultural history from 600 BC to AD 800 as the 'Ayurvedic period' because he credited Ayurveda with the origins of not only medical sciences but also chemistry and, if one may add, plant and animal sciences. The philosophical climate in the *Samhita* phase was so vibrant that Ayurveda, especially Caraka, was influenced by, and contributed to, the ongoing philosophical currents in India. An Ayurvedic view of life must therefore consider the rich background against which medical themes appeared to complete the big picture. In a great painting, an artist achieves harmony by composing different parts into a unified whole by design. In the 'Last Supper', Leonardo achieved this harmony by emphasizing the figure of Christ, who was silouetted against a window behind him. All the lines in the background which receded into the distance seemed to converge on him. One could hardly imagine the Last Supper if the scene were shifted to a shallow room with different background! Divested of its background, Ayurveda would be reduced to no more than a system for medical practice. It is therefore appropriate to outline the background which enlivens the Ayurvedic canvas.

Man and the cosmos: common constituents (pancabhūtas)

The constituent elements of the universe and those of the smaller universe within the human body are identical and their response to varied stimuli is also identical. The universe as macrocosm and the human body as microcosm was always a dominant theme in Ayurveda, which regarded man as a part of all that exists and the human body as a cosmic resonator. The universe is known to us through our five senses which have specific objects of perception, such as what the eye sees, ear hears, tongue tastes and so on. The elements perceived by the five senses and their derivatives (*pancabhūtas*) constitute the universe for Ayurveda, which has little to say on a supra-sensory universe. The tissues of the body, no less than food and medications, are composed of the five elements and their derivatives. It is this identity of composition which underlies the central principle of Ayurvedic therapeutics that mandates the choice of food and drugs from without for producing effects within the body. It was believed that this principle could hardly operate in the absence of identity between the substances in the external world and the smaller world within.

Evolution of the universe (pariṇāma)

How did the universe with its immense diversity begin? How did it evolve? These questions belonged to a field which had been ploughed earlier by Sāṅkya philosophers, and which was of great interest to Caraka, whose medicine was deeply rooted in the philosophical soil. According to him, all that exists evolved from avyakta – an unmanifest, undifferentiated, incoherent and primordial state of existence. A perturbation in Avyakta led to a cascade represented by Mahat (buddhi/consciousness) → Ahankāra (individuation) → Tanmātras (subtle forerunners of five elements) → Indriyas (five sense organs and five motor organs) → Manas (mind) → five Indriyārthas (objects accessible to the five senses), which totalled 24 categories^{1,2}.

Evolution of the universe began when a perturbation occurred in avyakta by the interaction of the forces of rajas and tamas, which were latent in it. This event belonged to the realm of chance, a random occurrence which could neither be predicted nor controlled. But once the perturbation occurred, the subsequent course of evolution through a cascade which ended in sense objects and the universe was pre-set, progressive and unalterable. To borrow Monod's phrase from a different context, the initial perturbation in avyakta was a chance event, but subsequent steps represented unalterable necessity. However, unlike Darwinian evolution which is irreversible and open-ended, the process of pariṇāma in Ayurveda consists of endless alternating phases of differentiation and expansion followed by another when the stupendous variety dissolved into the original, undifferentiated avyakta. This process had no external control and was blind to the sufferings of man. Caraka's view of evolution was 'harsh' and admitted no role for God in the process. According to him, the universe in some undifferentiated or differentiated form was always there and would always be there.

Equilibrium (sāmya)

Ayurveda regarded equilibrium as the essential condition of good health and well-being. But equilibrium was a collective term which included several individual components that were not interchangeable. The seven tissues (dhātus) of the body (muscle, fat, bone, blood, etc.) had to maintain dhātusāmya; the fires (agni) which constantly burn in the tissues and make things happen had to preserve agnisāmya; and doṣas, the all important products of digestion, without whose perturbation no disease could occur, had to keep doṣasāmya. Sāmya involved the interaction between the body and the environment as the six seasons ranged from the very hot to the very cold (ṛtusāmya). This called for adjustments on the part of the body, some of which occurred naturally such as sweating during summer and shivering in winter. But Ayurveda prescribed

food, drinks, physical activity, medical procedures and general conduct to supplement natural adaptation and maintain equilibrium through the change of seasons³.

Sāmya also included hetu (cause), which gives an insight into the role of causes in the genesis of disease as understood in far-off days. Causes were countless and were classified under four large groups (due to the perturbed doṣas, to external events such as floods; to the wrath of the gods; to imprudent conduct). They exist all the time, everywhere and can never be eliminated. Nevertheless, people generally remain healthy, suggesting that something more than a cause is necessary to produce disease. Ayurveda held that a breakdown in the equilibrium between the body and the co-existing cause (hetusāmya) was the principal factor in the genesis of disease, cause playing a supportive role. Instead of taking arms against innumerable causes in a fruitless and unending chase, Ayurveda argued, it would be wiser to restore hetusāmya by appropriate measures, when causes would take care of themselves.

A full life

Ayurveda offered a model for living, which stands in sharp contrast to the traditional view that Indians prized asceticism and renunciation, and disparaged affluence and a life of comfort. Caraka stated explicitly⁴: 'A person with a normal share of strength and combativeness, who is of sound mind and concern for things here and hereafter, is moved by three desires. These are the desire for life, for wealth and for life hereafter. The desire for life comes first, because the loss of life amounts to the loss of everything. To ensure good life and health, the observance of a code of conduct is necessary, just as careful attention needs to be paid for the proper care of illness. The pursuit of wealth comes next, because wealth takes second place only to life. There is scarcely anything more miserable than a long life without the means to live. One should therefore work hard to make a living by engaging in farming, animal care, trade, service and similar occupations. The third desire concerns life in another world after death, which does indeed raise many doubts.'

The desire for long life in good health found expression in the prescribed code for living, which is a far cry from asceticism⁵. The code laid great stress on personal hygiene; guidelines on nutrition and tasty food, appropriate clothes and jewellery, sexual intercourse, social relations and enjoyments, which are the elements of a full life. While virtues such as truthfulness, rectitude, fearlessness, modesty, courage, forgiveness and kinship to all forms of life were extolled, there was no bar on the celebration of life and the use of rasāyanas to enable one to live for a hundred years. A whole section in *Caraka Samhita* was, in fact, devoted to rejuvenant therapy⁶, which was claimed 'to ensure prolonged lifespan, youthfulness,

good health, fine voice and complexion, suppleness, intellect, power of retention and strength'. Caraka devoted another section to vājīkaraṇa, which consisted of numerous formulations to enhance sexual vigour to the level of a horse's⁷.

The elaborate description of various items of food and drinks, the protocol for dining, the enjoyment of many types of wines and a wine party, which are elaborately described in Ayurvedic texts should leave one in no doubt that, barring a minority who were ascetically inclined, the vast majority of people sought to live a full and enjoyable life.

Training of a physician

Side by side with the ancient Gurukulas, universities such as Takṣaśīla imparted medical training as recorded in Buddhist literature. The pupils were chosen with great care and were required to possess a liberal education which included sacred and secular literature, grammar, logic, philosophy, astronomy, astrology, mathematics, botany and mechanical arts. The selection was made on the basis of physical, mental, intellectual and moral attributes, besides the aptitude for arduous training for several years⁸. Initiation was done during a sacred ritual, which involved the pupil taking an elaborate oath on the conduct of a physician in training⁹. The academic training consisted of learning by rote and more importantly, by discussions. *Caraka Samhita* is indeed based on such discussions which were vigorous, free and highly educative. Practical training was given at the bedside, during domiciliary visits, and by participation in the identification of herbs during field trips, preparation of drugs and performance of medical and surgical procedures. At the conclusion of training, which was determined by the preceptor, the student had to obtain Royal permission to start practice. The *Arthaśāstra* of Kautilya had laid down severe punishment for those doing medical procedures without Royal permission.

Extraordinary importance was attached to training in debates, and Caraka went to great lengths to discuss hostile and friendly debates, definition of many logical terms, techniques to worst the opponents and so on¹⁰. This was important for a physician who wished to challenge an opponent for a debate on his doctrine or method and defeat him to win fame and adherents. This tradition of disputation was not confined to Ayurveda. Strict guidelines applied to the debaters such as 'not a word should be spoken which is not well thought out or which is out of place or which is confused or lacking in scriptural authority'. Triumph in a major debate or disputation strengthened one's claim to become a royal physician.

Destiny (daiva)

The human condition is smitten by suffering which is the constant companion of a physician's vocation. Traditional

systems of Indian philosophy regarded false knowledge as the ultimate cause of human bondage and suffering and sought, in different ways, the liberation from bondage by ridding oneself of false knowledge. Caraka held, on the other hand, that suffering resulted, in the final analysis, from errors of judgement and imprudent conduct (prajñā-parādhā). Unlike false knowledge which is a metaphysical concept, erroneous judgement is mundane and offered better possibilities for mankind for avoidance or correction. But how free is man to avoid flawed judgements and imprudent conduct? This question brought Caraka into an illuminating discussion on human destiny, which had been debated in India for centuries. One view held that fate was supreme, and no human effort could make the slightest difference to its inexorable operation; another view known as pauruṣeya and championed by Yogavāsiṣṭha, claimed that the heroic endeavour of man could indeed alter the course of destiny. If predestination is carried to its logical conclusion, Caraka pointed out, much of human effort, including the practice of medicine would become futile. Granted that no human effort could ward off the consequences of evil acts of great sinfulness, he noted that the bulk of what one does in a workaday world lacked a moral content in so far as it related to the business of daily living. Caraka argued that if a person chose to remain well by paying attention to hygiene, nutrition and proper conduct, one could not claim that his consequent well-being had been preordained. While the effect of Karma was unalterable for crimes and sins of great magnitude, errors which were the lot of the human condition could be prevented or corrected by adherence to proper conduct. This essentially involved the avoidance of the overuse, underuse and misuse of the senses and the mind. Caraka did not advise the renunciation of desire or non-attachment, but commended a full and righteous life which could be enjoyed in harmony with one's environment. A healthy life, according to Caraka, had to be a righteous life.

Habitat

Ayurveda inherited the Atharvan adoration of nature, which was amply reflected in the background of the discussions held in Atreya's hermitage, and in the surroundings of a house for healing described by Caraka. It recognized, however, that beneficent nature and the habitat for living beings were ever susceptible to devastation by epidemics and other calamities, which was termed 'janapadodhvasana'. Polluted air, water, land and disorderly seasons had the power to wipe out populations and destroy the habitat¹¹. Ayurveda took the view that the root cause for calamities which devastated human habitat was unrighteous and sinful living. Rulers lacking in probity would treat officers, traders and people so unjustly that righteousness would disappear altogether and even 'gods

would take leave of the country'. Unrighteousness would also invite ruin by war and violence, which were triggered by greed, anger and conceit. Epidemics and devastation were a warning to statesmen of the perilous state of governance. The surest remedy and best prophylaxis for this catastrophe was wise living, ethical conduct and harmony between man and his surroundings¹².

Medicine in Ayurveda

Approach to the practice of medicine

While keeping out of trouble by observing a code of conduct (svasthavṛtta) occupied centre stage, Ayurveda recognized man's vulnerability to disease and attached the highest importance to the practice of medicine to get one out of trouble (āturavṛtta). The role of medicine was akin to giving a helping hand to men who had fallen in a pit they had dug themselves and from which they might escape on their own only with difficulty¹³. Medical practice demanded a quartet – physician, medications, helper and the patient – each possessed of special qualities¹⁴. Among the quartet, the physician was the most important because of his knowledge and his role as a leader and coordinator. When the quartet was complete and each member had the prescribed qualities, treatment would succeed and restore the equilibrium of tissues and doṣas and make the patient well. However, it was incumbent on a good physician to recognize before treatment whether the disease was curable, palliable or incurable¹⁵. His guiding principles were friendship and compassion towards the ill, joy in treating those amenable to therapy, and masterly inactivity towards patients with incurable diseases¹⁶. When a major or risky treatment was contemplated for a grave or incurable illness, the physician was obliged to share the information with the family of the patient. The three great texts (*brhatrayee*) made no reference to yogāsanās or meditation as ancillaries to the practice of medicine. The use of mantras was infrequent, and astrology played a minimal, if not nil, role. Though compassion was recognized as the motive power of medicine, physicians were not forbidden from accepting a fee for service, except from sages, teachers and so on. The texts suggested a line of treatment slanted in favour of the affluent, but Caraka was sensitive to the problems of the poor and prescribed treatment 'without frills' for them¹⁷.

Diseases

The *Samhitas* are encyclopaedic in the coverage of diseases, which were always seen and managed through a framework of perturbed doṣas. As a bird in flight does not go beyond its shadow, diseases, according to Vāgbhata, do not transcend perturbed doṣas¹⁸. Every disease would have distinctive clinical features and would require a dif-

ferent treatment depending on whether it was precipitated by perturbed vāta, pitta or kapha, or their combination. As doṣas involve the whole body, every disease was systemic in Ayurveda which did however recognize, for practical purposes, regional and specialized disorders. Examples are diseases of the head and neck, eye diseases, poisoning, and disorders in children. Surgical conditions were dealt with by specialists who had received training in the discipline (śalya) as taught by Suśruta.

On the basis of counting the number of references to diseases in the *Caraka Samhita* (using a digitized text made by Yamashita of Kyoto University), a probable picture of the prevalence of diseases in Caraka's time (1st century AD) could be constructed. This analysis showed that the references to infectious diseases such as tuberculosis, leprosy and cholera were twice that of non-infectious diseases, including heart disease, anaemia, diabetes, epilepsy, etc. in Caraka's India. This finding from archeo-epidemiology would sit well with the disease pattern in the 'pre-transition' stage of an ancient society, as postulated by modern epidemiology¹⁹.

The natural history of diseases and their prognosis were always discussed at length in Ayurveda. The elaborate signs of approaching death (riṣṭa) were required to be learnt by physicians, and they were put together from medical experience and colourful popular beliefs. The exhaustive discussion on the signs of death would suggest that a class of specialists probably existed, who were experts in the care of the dying.

Treatment of diseases

Diagnosis was given great importance. It was based on interrogation, inspection, palpation and listening to bowel sounds, etc. In fact all senses, excluding taste, were employed in the diagnostic process. Counting of pulse entered Ayurveda long after Vāgbhata. Keen observation was supplemented by astute inference and the teachings of great predecessors. According to Caraka, physicians who are unable to explore the 'dark interior of the body with a lamp of knowledge and discrimination' could never treat patients with success. An ancient text (*Mādhavanidāna*) was, in fact, exclusively devoted to the diagnosis of diseases.

Once the diagnosis was made in terms of the perturbation of doṣas, therapeutic measures were put in place promptly, as delay was condemned. For mild perturbation, simple measures (śamana) such as fasting, rest, etc. were sufficient; but copious perturbation which manifested in serious diseases would call for the elimination of accumulated and vitiated doṣas (śodhana) and the restoration of doṣasāmya. This involved rest, dietary regimen, evacuative measures (pancakarma) and the administration of various drugs of plant, animal or mineral origin. Lifestyle, dietary regimen, cheerful atmosphere and faith in

the physician and his method were as important as herbal drugs and procedures for successful treatment. The drugs and procedures were always chosen on the basis of their properties being opposed to those of the perturbed doṣas. If the perturbed doṣas were acidic, for example, the medicinal formulation would be alkaline. If the patient's condition was surgical or became surgical, he was referred to the surgeon. Many of the procedures adopted for treatment were based on a 'mechanism of action' as conceptualized by ancient physicians. Pancakarma is a good example of their talent to see images of events in the mind's eye when they were absent before the senses, and move them about inside 'one's head' to work out new arrangements for a possible mechanism. This was not done by deduction, but by a blend of speculation and insight, which would qualify as induction. In the treatment of patients, yoga, meditation and astrology played a minor role in the *Brhatrayee*. Auspicious configuration of stars was chosen, not always, for conducting major elective procedures, and chanting of hymns reserved for special occasions only.

When evacuative therapy or other major procedures were prescribed, the patient was admitted to a 'house for treatment'²⁰. Caraka gave detailed guidelines on its ideal location; building plan with rooms for the patient, attendants, physician, cook, kitchen, store for medicines and equipment, bath, etc. The house had to have in attendance musicians, singers of ballads and associates who could relate to the patient easily. Its locale had to be home for birds, animals like hare and antelope, and gifted with plenty of greenery and supply of pellucid water. Caraka even gave directions on the furniture, upholstery, and vases for flowers in the patient's room! Obviously the house for treatment was designed to heal the mind as well as the body.

Surgical procedures

Ayurveda excelled in surgery, which was synonymous with the Dhanvantari School of Suśruta in Varanasi. He probably lived before Panini, who made three references to him in the *Aṣṭādhyāyī*. *Suśruta Samhita* dealt with cadaveric dissection to learn anatomy; use of fruits, leather bags, and various other models to practice basic surgical techniques such as incision, excision, extraction, suturing and tapping; pre- and post-operative care; a large number of procedures such as the setting of fractures, couching for cataract, removal of bladder stone, plastic repair of the nose, drainage of abscesses, and surgical methods including kṣāra sūtra for treating anal fistula. Among the many surgical procedures Suśruta described, trephining of the skull was not mentioned. It was performed by Jivaka – Buddha's physician – a few centuries later. Suśruta described 20 sharp and 100 blunt instruments, and gave directions on their proper use.

In Suśruta's period, surgeons were respected as Ācaryas, but the position had already begun to change by the 5th–6th century, when surgeons and all others who used their hands to make a living – masons, carpenters, weavers, farmers, blacksmiths – found themselves downgraded by a travesty of social engineering. This was the beginning of a long phase of intellectual stagnation and decline, when brain was disengaged from the hand and the springs of originality ran dry in India.

Epilogue

Echoing the *Mahābhārata*, *Caraka Samhita* proclaimed 'whatever is found here, may be found elsewhere; whatever is not found here, will be found nowhere'²¹. The vast stage and the immense range of things and events which characterize the phenomenon of Ayurveda would undoubtedly bear out the claim of Caraka. Ayurveda recognized the identity of man and the cosmos as a central reality and upheld the dynamic equilibrium among the constituents of the universe – living and nonliving – as the necessary condition of existence. The equilibrium was credited with in-built mechanisms to withstand shocks and restore itself, which could be glimpsed in the spontaneous recovery of function from dysfunction in many a diseased state (svabhāvoparama). The role of Ayurveda was no more than to assist the process of recovery and maintain good health by safeguarding the state of equilibrium.

While Ayurveda had ample tools and remedies in its vast storehouse, it enjoined virtuous conduct as the sovereign prophylactic against maladies and the unflinching guarantor of well-being. This was brought out in full measure by Vāgbhaṭa through numerous verses in the *Aṣṭāṅgahṛdaya*.

Consider the following: 'All creatures seek happiness in whatever they do: but happiness cannot be had without righteous conduct. Therefore righteous conduct is obligatory for all'²².

On the attitude to fellow-beings: 'One should always regard even mites and ants as no different from oneself'²³.

Towards a foe: 'One should be of service to him who may be intent on doing harm'²⁴.

In adopting the middle path²⁵: 'Neither torment nor pamper sense organs'²⁶. In the quest for knowledge: 'The whole world is a teacher for the wise in all he does; therefore, a man of action in the world's theatre should emulate its example'²⁷.

On virtuous conduct in general: 'Compassion for living creatures; charity; tamed body, speech and mind; regarding others as one's own'²⁸. 'Nights and days roll on; one who ever reflects "how have I spent my nights and days" would never grieve'²⁹. 'Giving up imprudent conduct; restraining the activities of senses; remembering one's

role in his noble calling; and cherishing the knowledge of habitat, time and soul, a physician should follow the path trodden by men of virtue³⁰.

‘One who enjoys wholesome food and activity everyday; who introspects on his actions; who is unattached; who is generous; who looks on all with an equal eye; who is truthful and forgiving; who delights in the service of virtuous men; he remains free from illness.’³¹

How to live a virtuous life was a golden thread which ran through, and bound together, the varied themes of Ayurveda.

Ayurveda prized knowledge and skill highly, but rated compassion and virtuous conduct even higher in a physician’s scale of priorities. Therein lies the key to its unbroken practice for 25 centuries and its resurgence in our times.

1. *CS Śārīra*, 1: 16, 67.
2. *CS Sūtra*, 1: 53.
3. *CS Sūtra*, 6: 48.
4. *CS Sūtra*, 11: 3–8.
5. *CS Sūtra*, 5: 71–75.
6. *CS Cikitsa*, 1: 1–3.
7. *CS Cikitsa*, 2: 1–4.
8. *CS Vimāna*, 8: 3–4.

9. *CS Vimāna*, 8: 13–14.
10. *CS Vimāna*, 8: 15–26.
11. *CS Vimāna*, 3: 6–7.
12. *CS Vimāna*, 3: 12–18.
13. *CS Sūtra*, 9: 3–12.
14. *CS Sūtra*, 10: 5.
15. *CS Sūtra*, 10: 9–22.
16. *CS Sūtra*, 9: 26.
17. *CS Sūtra*, 15: 19–21.
18. *AH Sūtra*, 12: 32–33.
19. Valiathan. M. S., *The Legacy of Caraka*, Orient Longman Pvt Ltd, Hyderabad 2003, pp. xlvi–lvii.
20. *CS Sūtra*, 15: 5–7.
21. *CS Siddhi*, 12: 54.
22. *AH Sūtra*, 2: 20.
23. *AH Sūtra*, 2: 23.
24. *AH Sūtra*, 2: 24.
25. *AH Sūtra*, 2: 30.
26. *AH Sūtra*, 2: 29.
27. *AH Sūtra*, 2: 45.
28. *AH Sūtra*, 2: 46.
29. *AH Sūtra*, 2: 47.
30. *AH Sūtra*, 4: 32.
31. *AH Sūtra*, 4: 36.

CS, *Caraka Samhita*; *AH*, *Aṣṭāṅga hṛdaya*.

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Soils of the Indo-Gangetic Plains: their historical perspective and management

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The Indo-Gangetic Alluvial Plains (IGP) is among the most extensive fluvial plains of the world and cover several states of the northern, central and eastern parts of India. The IGP occupies a total area of approximately 43.7 m ha and represent eight agro-ecological regions (AER) and 14 agro-ecological subregions. The area of the IGP is nearly 13% of the total geographical area of the country, and it produces about 50% of the total foodgrains to feed 40% of the population of the country. Thus the sustainability of the present cropping system and also the health of the soils demand a review on the historical development of the soils and their management that remained associated with the tectonic, climatic and geomorphic history of the IGP since it came into existence due to collision of the Indian and Chinese plates during the Middle Miocene. This review provides a state-of-the-art information on the historical development of soils of the IGP, their tectonic-climate-linked natural degradation during the Holocene, and changes in the levels of carbon in soils under agriculture (mainly rice–wheat cropping system), practised over the years. In view of the vast area of the IGP, research initiatives on benchmark soils are, however, still needed to record the subtleties in pedogenesis, especially their polygenetic history due to climate change during the Holocene. This way a historical soil–climate-crop databank may be established to help in fine-tuning the existing management interventions of the national agricultural research system and also the system-modellers in predicting future projections on the sustainability issue of the rice–wheat cropping system in the IGP.

Keywords: Climate change, historical soil development, Indo-Gangetic Plains, polygenesis, soil management interventions.

THE Indo-Gangetic Plains (IGP) ranks as one of the most extensive fluvial plains of the world. The deposit of this tract represents the last chapter of earth's history. It came into existence due to the collision of the Indian and Chinese plates during Middle Miocene¹. The Indian plate is still moving at the rate of 2–5 cm/yr towards the north and forming the world's highest mountain range on its

border. The north-south compression generated throughout the plate ensures that it is continuously under stress and provides the basic source of accumulating strain in the fractured zones². The fluvial deposits and landforms of the IGP have been influenced by the stresses directed towards north and northeast. The major rivers of the IGP have changed their courses and, at present, are flowing in southeast and easterly directions with convexity towards the southeast, which is strikingly similar to the arcuate pattern of the major thrusts bordering the IGP³. Thus the IGP shows a series of terraces, bars and meandering scars resulting in microhigh and microlow areas on the apparently smooth topography^{4,5}. The IGP is still tectonically active and the major sedimentation is taking place from large river systems of the IGP. The IGP developed mainly by the alluvium of the Indus, Yamuna, Ganga, Ramganga, Ghagra, Rapti, Gandak, Bhagirathi, Silai, Damodar, Ajay and Kosi rivers. Geophysical surveys and deep drilling by the Oil and Natural Gas Commission of India^{6–8} suggest that the IGP is a vast asymmetric trough with maximum thickness of 10,000 m, that thins out to the south. The IGP covers about 43.7 m ha and represents eight agro-ecological regions (AERs) and 14 agro-ecological subregions (AESRs; Figure 1)⁹. The nature and properties of the alluvium vary in texture from sandy to clayey, calcareous to non-calcareous and acidic to alkaline. Though the overall topographic situation remains fairly uniform with elevations of 150 m amsl in the Bengal basin, and 300 m amsl in the Punjab plain, local geomorphic variations are significant¹⁰.

Early studies on soils

Agriculture was the mainstay of the people of ancient India. The agriculturists then were quite conscious of the nature of soils and its relation to the production of specific crops of good economic return^{11,12}. Archaeological investigations along many important sites in the southern, central and western parts of the IGP suggest considerable progress from incipient agricultural activities to well-developed agricultural practices over a span of the last 10,000 years^{13–18}. According to recorded information ancient India during the period 2500 BC to AD 600, a vast knowledge acquired by the then agriculturists by

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