movement into another rise to prominence and demand systematic attention

See also externalism

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SS

hidden variables. Any set of hypothetical physical quantities, knowledge of whose values would permit more precise predictions of the results of measurements on a system than the statistical predictions of *quantum theory One historically important reason for postulating such quantities was to avoid quantum *indeterminism Orthodox interpretation of quantum theory denies that hidden variables exist Nevertheless, several theories incorporating them have been proposed, notably by David Bohm (*b* 1917) It has been claimed that quantum theory is inconsistent with the existence of hidden variables, and various proofs have been offered, including an early and influential proof by John von Neumann (1903–57) Other physicists, including Werner Heisenberg (1901–76) claimed that at least contemporary hidden variable theories yield no new experimental consequences, but give merely inferior restatements of quantum theory The situation has been clarified by work since 1960, notably by J S Bell (*b* 1928) Although one can construct a formal hidden variable model of any quantum system, there are reasons for believing this cannot always be of physical interest, either as an interpretation of quantum theory, or as a potential successor to it Where the predictions of any physically plausible hidden variable theory must diverge from those of quantum theory, experimental tests to date are usually interpreted as having favoured quantum theory

RAH

high-energy nuclear physics. *See* cosmic rays

high-velocity stars. *See* galactic rotation

Hindu science. The most spectacularly successful of the sciences in Ancient and Mediaeval India was linguistics (Sanskrit, *vyakarana*, 'analysis' or 'variformation') Linguistics acted as a paradigm for the methodology and style of expression of other disciplines, especially in such fields as logic and *philosophy, fulfilling the role which in the West was taken by *mathematics and *geometry In the study of language India has made one of her most lasting and important contributions to human knowledge

In the 4th century BC Pānini Daksiputra brought to fulfilment a tradition of grammatical study which was already ancient in his day His work, the *Astadhyayi* ('the eight chapters'), consists of just under four thousand short rules called *sūtras* ('aphorisms') They consist on average of seven syllables each, which gives an idea of the brevity of the work Compared to the Western tradition, Panini's grammar is far more like post-Chomskian language descriptions than the traditional primer or grammar text, being entirely generative in its method, while the *kāraka* ('participant in an action') theory of the semantics of case, nominal suffixation and sentence syntax is frankly transformational The whole rests on a thorough understanding of the principles of phonetic description and morphological constituent analysis

The techniques so successfully applied to the study of language, especially the concept of economy in method and the adoption of a technical terminology, were taken over by several other disciplines This occurred naturally since Sanskrit has always been the medium of Indian scientific writing, so any young scholar had first of all to undergo a rigorous training in grammar before moving to his chosen speciality

The original impulse for the study of astronomy was the need to be able to recognize the right moment for an action, in particular a religious action This is reflected quite clearly in the earliest or Vedic period (*c*1500 BC) when various *calendrical parameters are mentioned in contexts concerning the times of sacrifices

After the Vedic period the four following periods are largely a record of how Indian astronomers ingested new theories from abroad, mainly from Mesopotamia and Greece, and changed them, sometimes improving them, always complicating them, marrying originally distinct system with great subtlety, and applying their undoubtedly great mathematical skills to the new problems From the 2nd century AD the chief purposes of astronomy were the casting of horoscopes and the production of almanacs

In mathematics, from the very earliest times, the Indians showed an interest in the extremes of very large and very small *numbers, their factors, powers and serial relationships From the first Vedic descriptions of number sequences

the decimal system is used, the sexagesimal system only from the 3rd and 4th centuries AD, with the influence of Greco–Babylonian astronomy The place value notation is explicitly described in the *Anuyogadvārā*, a Jain work from the 1st or 2nd century AD, but the system is probably much older

The first systematic treatises of a mathematical nature are the *Śulvasutras*, texts ancillary to the Vedic ritual which teach the laying out of sites and the construction of altars of various shapes They are probably not older than the 7th century BC and present a rich and impressive tradition of geometry and mensuration, with a recognition of generality as a scientific aim

The greatest abstract achievements in this early phase of Indian mathematics were in *geometry and in the establishing of the decimal system, using the zero [*number systems] Mediaeval Indian scholars excelled in *algebra, with the solution of indeterminate equations, and series Throughout the tradition runs a deep interest in both arithmetic and geometric series, their terms and summation The expansion of the simple binomial $(a + b)^n$ for $n = 2$ is mentioned as early as the *Śulvasūtras*, while Mādhava of Sangamagrāma (*c*1340–1425) gives the full power series expansions for sine and cosine This preoccupation with arithmetic and algebra may be contrasted with the ancient Greek brilliance in geometry

Indian medicine is both ancient and rich The Sanskrit name for medicine, *āyurveda*, actually means 'the knowledge for longevity' This points up a slightly different emphasis from current cosmopolitan practice, for *āyurveda* is concerned not only with curing sickness, but with maintaining health There is a great deal of instruction on *diet and *regimen, with adaptations for personality type, age, the season and the like

The human being is viewed as a conscious witness (*purusa*) embodied in a blended complex of the five *elements, aether, air, fire, water and earth, and set in motion by the vital breaths (*prānas*) Of these elements three are of special importance to health air, fire and water, which when considered in relation to the body are called wind (*vāta*), bile (*pitta*), and phlegm (*slesman*) They are referred to collectively as the three 'problems' (*dosas*), usually translated as *'humours' Disease is an imbalance of these three elements in the body, the task of *āyurveda* is to re-establish and maintain their balance

Āyurvedic herbal medicines are still used and it seems the traditional medicines are often highly effective

The earliest treatises on *ayurveda* contain chapters on surgery Elaborate techniques are described and classified Eye operations were particularly well understood However, although doctors continued to learn the surgical texts by heart, they ceased several centuries ago, probably for caste reasons, to do operations Surgery was indeed practised, but not by medical men British doctors of the East India Company first witnessed a demonstration of plastic *surgery in India

The techniques of *āyurveda* were also adapted for the care of animals Elephants, horses, cows, dogs, falcons and others are all discussed in what is probably the world's oldest veterinary literature

A branch of medicine which concerned itself with artificially prolonging the life of the body grew into a complex *alchemical system Mercury was divinised and formed the basis of most elixirs, but many other *metals were subjected to chemical processes such as oxidation, reduction, carbonation and sulphuration

As to the physical world, *physics was never separately studied and the several philosophical schools each had their own notions of substance and its behaviour The most widely held teaching was an emanationism seeing the physical world as the last and grossest stage in a causal chain of elements starting from the finest, consciousness itself *Atomism was known from the 6th century BC and was invoked to explain the formation of the elements, excepting *aether Where one would nowadays use the concept of *force the Indians often speak of Great Time But there are discussions about impulse or impetus (*vega*) and its role in keeping a projectile aloft On the other hand, the motion of bodies is often described as an innate quality, rather than as a function of time, although the astronomers understood the latter view In general, however, these concepts remained the prerogative of the philosopher and not the scientist But this distinction between scientist and philosopher is a modern one In Ancient and Mediaeval India, as in Europe, all fields of serious intellectual endeavour were called 'sciences' (Sanskrit, *sāstra*)

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DW

Hippocratic oath. *See* Hippocratism

Hippocratism. The great physician Hippocrates of Cos (*c*450–*c*370 BC) left no identifiable writings, and his opinions as recorded by contemporaries are not distinctive He considered 'the whole' in looking at a diseased person or part, carried out a method of logical division of possibilities in *diagnosis, and taught for money His reputation was such that many works passed under his name or were later catalogued as his by credulous librarians to form our 'Hippocratic corpus' Among these varied treatises, some, especially *Epidemics*, *Prognostic* and *Aphorisms*, were regarded as preserving genuine theories, and their doctrines can loosely be said to constitute Hippocratism

In Hippocratism, the patient was viewed as an individual, his diseases were his own, depending on the imbalance of *humours *Anatomy played little part in diagnosis, and *physiological theories were usually simple Treatment was largely allopathic and based on *diet Such drugs as were used were almost all *herbal, and *surgery was minimized Expertise in bone-setting and reducing dislocations was highly valued, but this was the limit of manual intervention Stress was laid on securing the cooperation of the patient in fighting disease, and the special and psychological value of *prognosis was emphasized as much as the diagnostic There were few general diseases, and their cause should be sought within the patient, although general climatic and *environmental factors were not disregarded, e g *contagion

Because of the heterogeneity of the treatises forming the 'Hippocratic corpus' and the deliberately obscure and oracular way in which many doctrines are expressed, Hippocratism was never as systematic as *Galenism (itself an interpretation of Hippocrates), and its flexibility enabled it to be interpreted in many ways from Meno (*fl* 320 BC) to the present day As late as the end of the 17th century, Friedrich Hoffmann (1660–1742) claimed Hippocrates anticipated Descartes (1596–1650) in understanding the essentially mechanistic workings of the body [*man-machine] The emphasis in Hippocratism on clinical observation and on following *Nature's way made it particularly attractive in the mid-19th century, the age of the greatest editor of Hippocrates, Littre (1801–81), as a way out of *therapeutic nihilism Its constant reappearance in the 20th century is as a reaction against 'disease-orientated' medicine and towards a consideration of the patient viewed as an individual whole The 'Hippocratic' Oath (which cannot be by the historical Hippocrates) is often claimed as a medical ideal of service to the art and the community and its precepts are invoked as if eternally and universally valid Others have found many modern concepts, including the blood-circulation, pre-figured in the 'Hippocratic corpus'

Although historians like Edelstein (1902–65) have sought to abolish the myth of Hippocrates as 'father of Western medicine', and to interpret the 'Hippocratic corpus' in accordance with the social, philosophical and medical conditions of its time, they have not succeeded in alerting the medical profession to the complexities and contradictions inherent in any revived Hippocratism

See also healing power of Nature, nosology

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VN

histamine. *See* inflammation

histology. *See* cell theory, development, digestion, generation, neurone theory, protoplasm, tissue

historical materialism. The Marxist method of understanding society It is **materialist* in that its primary focus is on how people organize