MAGICAL MOMENTS IN MEDICINE
Part 4: Indian, Chinese & Islamic Medicine

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Most chronicles which document the history of medicine generally eulogise Greek philosophers and healers for the invention of scientific and rational medicine. While it is a fact that Greece has contributed handsomely towards the evolution of medicine as a scientific discipline, it is also true that European scholars, accustomed to trace roots of Western culture back to Greco-Roman times, commonly disregarded the development of medicine, science and philosophy in the East, especially in Arabia, China and India. Magner, in his book has noted that this is particularly distressing, since the medical traditions of these countries are very much alive, unlike the extinct traditions of Egypt and Mesopotamia.

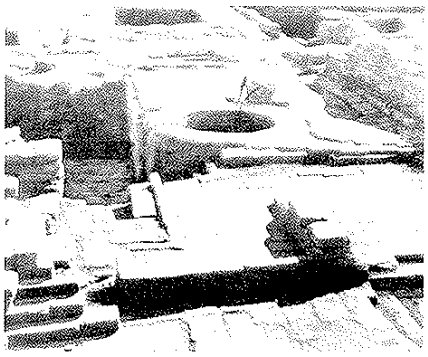
In this episode, we shall attempt to explore three great eastern healing traditions, which among them held a vast amount of medical erudition, contributing significantly towards medical concepts of the present day.

Indian Medicine

Even as it races with China, vying to attain the most populous nation status by the year 2050 (with two babies being born every three seconds), India, with its diversity in race, religion, culture and language, presents a profile of bewildering complexity. Its medical traditions can be traced back to the 15th century BC.

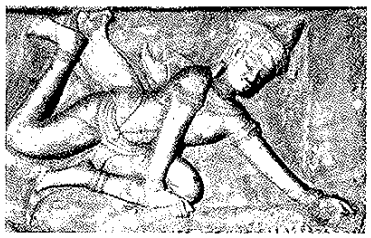
The sands of Sind, (now in Pakistan), kept deep within them, a well guarded secret for centuries. Glorified grave diggers - simply called archaeologists - brought to light the remains of a civilisation going back 5000 to 6000 years and perhaps even further, when two ancient cities called Mohenjodaro and Harappa were excavated in the 1920's. These cities, which were part of the forgotten Indus Valley Civilisation, were well planned and constructed and included houses having adjoining bathrooms, wells and an elaborate public drainage system. (Picture A). Some scholars even believe that ancient Indian civilisation dates back from a period contemporary with the Egyptians and Babylonians.

Three significant periods are described in the development of ancient Indian medicine. The Vedic period started with the Aryan invasion of Punjab around 1500 BC. Aryan culture was amalgamated with the local Hindu style of life and the intricate blend saw the emergence of a new era in culture, art and medicine. Sanskrit itself was one of the dialects of the Indo-European linguistic family, brought to India by the conquering Aryans. Scientific books called Vedas (Sanskrit for knowledge) were composed during this period, the four main Vedas being Rig, Yajur, Sama and Atharva Veda. Atharva Veda is the



Picture A. Paved bathroom and brick well (3300 BC) excavated in the ruins of Mohenjo-daro, indicating the advanced sanitation levels rivaling Mesopotamia and Egypt. *(From Medicine - An Illustrated History)*

earliest Indian document in which many medical references are found, but these are primitive and impregnated with a lot of magic and sorcery. *Ayurveda* (knowledge of long life) is considered an off-shoot or ancillary of the Atharva Veda and dealt particularly with medicine. Its authorship is allegedly attributed to Dhanvantari (Aesculapius' Indian counterpart). Ayurveda, however was not written in his divine capacity. Dhanvantari, (Picture B) a god who supposedly arose from the churning of a sea of milk, was in later life believed to have been moved by the sight of ailing mankind. He is said to have assumed mortal status after being born on earth as a prince, only to later relinquish his position to become a hermit. Withdrawing to the woods he is reported to have eventually prepared the sacred healing book, *Ayurveda*.



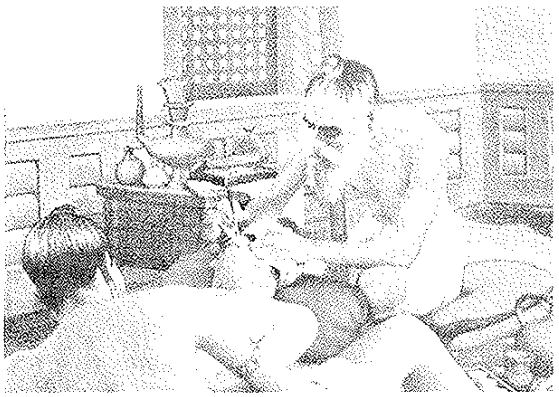
Picture B. Dhanvantari, the patron deity of Indian medicine *(From Medicine - An Illustrated History)*

The second period started around 800 BC and all kinds of learning - be it culture, art or medicine - was totally dominated by a priestly social sect called the Brahmins and the term *vaidya* was applied to all practitioners. The Brahminical period, which represented the peak of development of Indian Medicine, saw the development of great doctors like Charaka, Susruta and Vagbhata - honoured as the "Triad of Ancients". The writings and commentaries of these semi-legendary authors, together with ancient Vedic teachings, helped to enrich the existing knowledge and formed the cornerstone for all the subsequent constructions on the magnificent edifice of Indian *Ayurvedic Medicine*. Ayurveda emphasised on a more "holistic" approach, thus dealing with the body, mind and spirit (or the physical, subtle and causal aspects of the disease).

Ayurveda was delineated into eight specific branches of medicine: internal medicine, diseases of the head, surgery, toxicology, demonic diseases, paediatrics, rejuvenation and aphrodisiacs. There were two main schools of Ayurveda at that time, *Atreya* - the school of physicians and *Dhanvantari* - the school of surgeons. These two schools made Ayurvedic medicine classifiable and scientifically verifiable. Through research and experimental testing, they dispelled the doubts of the more practical and scientific minded, removing the aura of mystery that surrounded the concept of Divine revelation. Consequently, Ayurveda grew into a respected and widely used system of healing in India. People from China, Tibet, Greece, Rome, Egypt, Afghanistan, Persia and numerous other countries came to Indian Ayurvedic schools to learn about this system of medicine and to take it back to their own countries.

Origin of organic life was classified into four groups: *Svedaja* or "sweat-born" (insects), *Andaja* or "egg-born" (birds, snakes and the like), *Jarayusa* or membrane-born (mammals) and *Udbhissa* or "sprout-born (all plants). Chaulmoogra oil was used in the treatment of leprosy and the Indian snakeroot (Rauwolfia serpentina) was used to relieve various disorders, until the early part of this century, when reserpine was extracted for its root when found dramatically effective in the treatment of hypertension and mental disorders. However, like most other civilisations, magic played an important role in ancient Indian medicine. Demons were put down as the cause for several diseases, even in scientific treatises.

Among the whole galaxy of ancient Indian healers, the one illustrious name which traditionally stands out is that of Susruta (Picture C). This distinguished man, who has been cited both by the famous Arabian physician Rhazes, as well as the Chinese Buddhist pilgrim I-tsing, also features in the famous Bower manuscript dated 350 AD. He was an eminent surgeon, and his work, called the *Susruta Samhita* (Susruta's Collection) includes not only surgical procedures but also some principles of medicine, pathology, anatomy, midwifery, biology, ophthalmology and hygiene. The descriptions of human anatomy, however, were comparatively less accurate in details. In fact, the records of that age that we have certainly do not compliment ancient Indian knowledge of human anatomy. Religious laws and beliefs and a taboo on cadaveric dissection could be the reason for this. Forced to comply with religious regulations, Susruta circumvented the problem by proposing an unusual form of anatomical investigation. He suggested that after removal of the excrement from the intestines, the anatomist should cover the body with grass, place it in a cage of fine mesh, and leave it to lie in a shallow pond. A week later, the anatomist could gradually remove successive layers of the skin by gently rubbing with soft brushes.

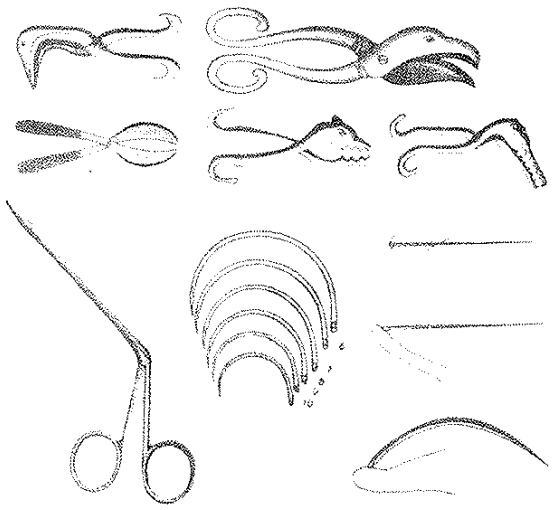


Picture C. Susruta, performing surgery *(From Great Moments in Medicine).*

Paradoxically, in spite of a weak knowledge of anatomy, he had superior skills in surgery and performed operations ranging from tonsillectomy to amputations. Susruta describes some 125 surgical instruments, including tongs, hooks for nasal polyp removal, rectal specula and even magnets for removal of metallic foreign bodies. The instruments were usually likened to animal parts like the 'lion's jaw' and the 'heron's bill'. (Picture D). Different types of bandages and dressings are described with their indications and contra-indications. Cataract operations were child's play for Susruta and his associates. Obstetric procedures described by Susruta indicates skill in this field not achieved in the West until many centuries later. Operations for haemorrhoids, fistulae and intestinal obstructions are all described in his book. Ancient Indian doctors were familiar with epilepsy, tetanus, hemiplegia, elephantiasis, ulcers and abscesses, osteomyelitis, scrofula, goitre and several venereal diseases. Susruta himself mentions no less than 1120 diseases and 760 herbal drugs.

An interesting mention is made of how wound suturing was done during that time. Various types and sizes of needles (Picture D) and thread were used for closing

simple wounds but when intestines were torn, the edges of the wound were drawn together and the mouth of a large black ant was applied to it. As the ant bit, it was yanked away, but in the process the head and mandible of the decapitated insect held the edges together as a biological clamp. Several such ants were used serially, until the entire wound was closed. Albucasis, the Arab surgeon in his medical treatise written much later, makes a mention about sewing up the colon with a certain species of big-headed ants. This technique of stitching up surgical wounds was used even as late as the 19th century by surgeons during the war between the Greeks and the Turks and might possibly be the forerunner of absorbable catgut.



Picture D. Ancient Indian surgical appliances and needles *(From Medicine - An Illustrated History)*

Records lead us to believe that ophthalmic surgeons often 'tricked' their patients into undergoing the operation of cataract removal. While pretending to examine the eye, the operator suddenly and unexpectedly thrust a needle into the cornea and quickly detached the opacified lens. The eyes were then bandaged and the patient advised complete rest for 24 hours. Considering the primitive modes of transportation in ancient days, this was a comfortable period for the surgeon to make a clean getaway, just in case things turned sour.

One aspect of human anatomy which all students were expected to master was the complex system of vital points called '*marmas*' (Picture E). These points, which parallel Chinese acupuncture, were thought to be the sites where major arteries, veins, ligaments and muscles unite and where injuries are likely to be incapacitating or fatal. The classical system had 107 points, each with a special name. From Susruta's book, we learn of the first science of massage, using the *marma* points for reference. Even the Polarity Massage Therapy, popular in America, is said to have been developed from ancient Indian massage techniques.

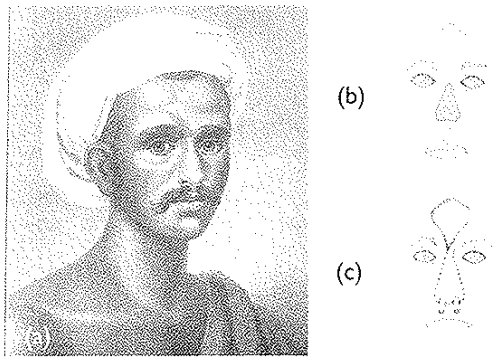
Charaka represented the Atreya school of physicians. Charaka's work the '*Charaka Samhita*' was the first great treatise of Indian Medicine and had eight volumes. The presentation was in the form of a dialogue between a teacher and his pupil. It discussed physiology, anatomy, aetiology, pathogenesis, symptoms and signs of disease; methodology of diagnosis, treatment and prescription of patients; prevention and longevity. Included were internal and external causes of illness. Charaka states that the first cause of illness is the loss of faith in the Divine. According to him, external causes of health included time of day, seasons, diet and lifestyle. There is a whole section discussing the medicinal aspects of herbs, diet, and reversing of the ageing process. For the skeptical modern person, who wonders if this ancient wisdom can be believed, one only needs to read Charaka's month-by-month description of the development of the foetus in the womb to see that it remarkably corresponds to what we know today from using modern techniques.

Picture E. Marma points in the arm *(From Medicine - An Illustrated History).*

Vagbhata's book refers both to Charaka and Susruta and is obviously the most recent. Not much is known about the author's biography.

In ancient Indian society, justice was meted out for wrongdoers in the form of physical mutilation and amputation, the severity and degree of punishment depending on the nature of the crime committed. A 'nose-cut' was the penalty for adultery (although one would have expected an amputation of the appendage concerned). This was probably in order to make the countenance gory and unpresentable for future advances towards the opposite sex. This apart, warriors (who were generally not used to fighting with protective headgear) landed at the surgeon's doorstep minus earlobes, noses and lips. Therefore, plastic and reconstructive surgery became the most remarkable aspect of the Indian doctor's achievements (Picture F).

During this period, diagnostic approaches were as much superstitious as they were rational. Omens played an important role. Although severity of disease was often measured by ridiculous parameters like flight of birds and sounds of animals, due attention was also given to the patient, especially his sputum, urine, stool and vomitus. Fever, dubbed as the 'king of all bodily diseases' was observed with great care, the intervals between peak periods giving the key to prognosis. In ancient India, diabetes was called 'the honey urine disease' is said to have been diagnosed by the sweet taste of urine, but it is not known whose gustatory faculty was used for the appraisal. Europe became aware of this procedure of detecting sugar in the urine only after about thousand years. The pulse, an important diagnostic tool, was well studied and classified into an elaborate system. For diseases which the physician thought was caused by improper diet, treatment commenced with a week long fast. Many recovered during this period and needed no other treatment. Some presumably died of starvation and also, needed no further treatment.



Picture F. The first nose jobs: a) Picture of an Indian bullock cart driver, whose nose has been successfully restored after punitive mutilation. When this picture appeared in the October 1794 issue of the *Gentlemen's Magazine* of Calcutta, it reportedly astonished the British sahibs and memsahibs. (*A History of Medicine*) b & c) Ancient Indian Rhinoplasty: A trefoil leaf shaped flap of skin was raised from the forehead, making sure that the end nearest the bridge of the nose remained attached. The flap would be brought down to where the nose should be, twisted skin side out and sewn into place. Two polished wooden tubes or hollow reed were inserted to keep the air passages patent during healing. New earlobes were also fashioned this way. *(From Medicine - An Illustrated History).*

Four types of disease have been described namely traumatic, bodily, mental and natural. A person is said to be healthy if the three *Doshas* (humours) - *vata* (wind), *pitta* (gall) and *kapha* (mucous) - are in perfect balance and in harmony. The basic principles of Indian humoural pathology appears similar to those proposed by Hippocrates, but Ayurveda gets complicated down the line. It states that five elements - earth, water, fire, wind and vacuum - and seven types of tissues constituted the body.

None of the ancient Indian texts on medicine make a mention about anaesthesia. In Susruta's time, suppression of pain was brought about by getting the patient drunk with generous quantities of wine. Inhaling the fumes of burning Indian hemp (cannabis) was also a method used to produce some amount of anaesthesia.

Ancient Indian medical literature reveal that personal and community hygiene were priority areas in their daily life. Tooth brushing twice a day, baths, massage, exercise, proper dietary habits, well-regulated sex life and adequate rest were emphasised. Variolation against smallpox was practised by inoculating people with pus from a small pox skin boil by puncture or scarification and it was from India that the Western world first learned of this method of prevention, which eventually led to the discovery of vaccines in the 19th century.

The third period followed the Muslim conquest in the seventh century AD, which brought Arabic medicine into India.

As has been observed by Keith, "The striking similarity between Greek and Indian medical systems has been long well known. We find in both such things as the doctrine of humours, whose derangement explains disease, the stages of fever and several other lines of thinking which resemble each other. Even the description of a dying patient clutching his bedclothes elaborated in Susruta Samhita is similar to the classical description given by Hippocrates in *Prognostic*. But it must be confessed that it is very difficult to determine how much is due to Greek influence and how much is merely parallel development."

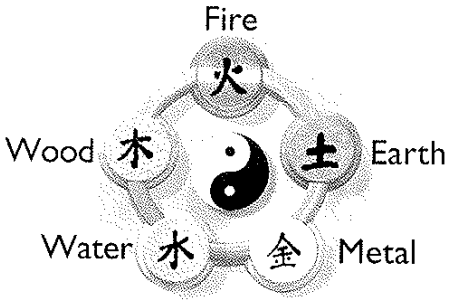
In his foreword to Dr. Julius Jolly's book Indian Medicine, Filliozat observes that 'Indian Medicine has played in Asia the same role as the Greek medicine in the West, for it has spread in the region as far as Japan, as Greek Medicine has done in Europe.' Today, even while India has allowed modern science and medicine to reinforce its medical system, Ayurveda still brings comfort to millions. But its connections with theology and links with religious sentiments have prevented its growth and made it relatively static. However, since Susruta's Samhita and other notable works of Charaka and Vagbhata were all translated into Persian and Arabic, around 800 AD and since Arabic medicine became the basis of European medicine around the 17th century, it can be said that Indian ideas live till this day, having indirectly found their way into modern Western medicine.

Chinese Medicine

Chinese medical traditions are among the oldest in the world and the systems of medicine developed in ancient China have survived till this day in almost its pristine form. In contrast to most other systems of medicine which have either mutated or modified with times, the fine Chinese art of medicine has maintained its identity to a great extent. Although the religion amalgamated a lot of magical and superstitious beliefs, it is said that even as early as 400 BC, Chinese medicine had evolved as a separate entity, efficiently handled by professionals. The doctors were classified according to their achievements and surgeons (not unlike the 'barber surgeons' of the West) were among the lower rungs of the ladder of medical hierarchy. The Chinese called these ulcer physicians 'third-rate graduates' and considered them only marginally better than veterinarians. Clinical successes and failures had to be reported for promotion and grading. Physicians who cured all their patients were ranked first class; the lowest grade was awarded to those who could not cure more than 60% of their patients. Examinations needed to be passed in order to practice. During the period of the Chou dynasty, (1122-255 BC), the government conducted yearly examinations of those who wished to practice and this was several centuries earlier than the first known licensing system of the West. The best candidates were selected for Imperial Service and attached to the Imperial College of Medicine. In the early 14th century, fourteen medical specialities existed in China, with complex subdivisions; doctors for great blood vessels, small blood vessels skin, larynx, mouth etc., Female physicians are mentioned in the Han dynasty documents as early as 206 BC.

Ancient Chinese believed that the universe was self-generated by the interplay of two forces - *Yang* and *Yin* - and not by divine direction. *Yin* was considered the moist, cold, negative, earthly and feminine power. It represented darkness and its literal translation means the 'shady side of the hill'. *Yang* represented the bright, dry, active, warm and positive masculine aspect derived from the heavens. Translated, it means 'sunny side of the hill'. *Tao* (meaning 'the way') was the ultimate principle of the universe which determined *yang* and *yin* in all living creatures. They believed that good health results from a delicate and harmonious balance between these two opposing, yet complementary forces. Anything that altered the balance was considered bad and which resulted in disease. Like the ancient Indians, they also believed in five basic elements (Picture G). Earth, water and fire were common in both countries, but the Chinese believed in wood and metal rather than in wind and vacuum. In fact, the number five was mystical for ancient Chinese who felt there were five elements, five seasons, five tastes, five kinds of drugs, five treatments, five emotions, five colours and five solid organs). According to Lyons, along with Buddhism, some medical concepts Yoga and Ayurveda also found their way to ancient China from India, which were partly incorporated in the gymnastic and breathing exercises in Chinese medical mythology. Chinese ambassadors who travelled far and wide, enriched medical science by bringing back information on drugs and other subjects.

The earliest works of medicine in ancient China are attributed to the Three Celestial Emperors; Fu Hsi, Shen Nung, the Red Emperor and Yu Hsiung, the Yellow or Golden Emperor. These colourful and legendary rulers are revered as the founders of Chinese Civilisation. The *pa kua* which is a symbol composed of *yang* and *yin* lines combined in eight (*pa*) separate triagrams(*kua*) is said to represent all yin-yang conditions(Picture G). Emperor Fu Hsi,(2900 BC) is said to have conceived the *pa kua*. He is also credited with the authorship of *I Ching* or Canon of Changes, considered the most ancient of Chinese books.



Picture G. The *pa kua* symbol, depicting the basic dichotomy in the Universe and the possible combinations of the two.

The compilation of the first Chinese medical herbal, the *Pen-tsao* is attributed to Shen Nung the Red Emperor, (2800 BC) who reports the effects of 365 personally tested drugs. He is also supposed to have drawn the first charts on acupuncture, which is presumably older than these emperors themselves. This "Divine Peasant" is supposed to have taught his people to sow five different types of grain and also to have tested several poisons on himself. He is reported to have, however, lost his life after an unsuccessful experiment.

Yu Hsiung, or *Huang Ti*, the Yellow Emperor, (2600 BC) supposedly gave his people the wheel, the magnet and the calendar, but outshone his predecessors by producing the *Nei Ching* or the Classic of Internal Medicine. This is thought to be the oldest and most comprehensive medical text in existence and combines medical theory with clinical practice. It is said that the wisdom contained within was transmitted orally for centuries before it finally was committed to writing, somewhere around the third century BC. A major

portion of the text is in the form of a dialogue between the Emperor and his Prime Minister, Ch'i Po, discussing various aspects of health, illness, prevention and treatment. The book also corroborates the basic principle of Chinese Medicine that the *yang* and *yin* forces which govern the cosmos and also the human body. For instance, ejaculation in intercourse was believed to reduce a man's *yang*, which upset his natural balance, but at the same time the balance was restored when he was strengthened by the absorption of the *yin* released from the orgasm of the female partner. Likewise, every system of the body was believed to be governed by the yang-yin philosophy. The *Nei Ching* describes 'blood current continuously flowing in a circle without stopping' and it is quite possible that Harvey was beaten to it by the ancient Chinese who seemed to have understood the principles of blood circulation millennia ahead.

The magnum opus of Chinese pharmacology is a 16th century work called *Pen-ts'ao Kang Mu* which is a Compendium of Materia Medica written by Li Shizen, China's purported "prince of pharmacists". It lists 1892 different herbal drugs as well as 11,000 prescriptions, apart from carrying over a thousand illustrations and 900 cross references. It could therefore be observed that in the history of Chinese Medicine, virtually every herb and substance found in nature has been used as a cure for some malady. In addition, Sun Szu-miao led a committee which produced a fifty-volume collection on pathology.

Drug anaesthesia was developed as early as the 2nd century; vertebral fractures were treated using suspension in the 12th century; inoculation for small pox (the 'heavenly blossom' disease) was a widespread practice in China during the 16th century. Doctors collected crusty scabs from small pox pustules and powdered them. The powder was then put into the nostrils; males snorted through the left nostril and females through the right side. These facts prove that the Chinese system of medicine was highly refined and advanced centuries before the same concepts were adopted by Western medicine.

Ephedra is a plant substance uniquely associated with China. It was described as *ma huang* the 'horse tail plant' by the Red Emperor useful in the treatment of respiratory diseases. It's active principle *ephedrine* was extracted and isolated in the late 19th century and has been a useful drug in Western medicine since. *Gin seng*, the 'man shaped root' which is popular right till this day, is almost a miracle herb to many. Ancient Chinese believed that it could delay ageing, increase libido, and calm the agitated and stimulate the fatigued. The gathering and preparation of ginseng was surrounded by a rich body of folklore, ritual and myth. Only wooden knives and earthenware pots were used to prepare ginseng since metal was believed to destroy its virtues. Wild ginseng was also supposed to roam about at night, with a luminous glow, disguised as a bird or a child, luring ginseng hunters to their death. Many research studies are on to find out the constituent structure of this root which has been attributed with such miraculous healing powers. Remedies made from noxious or repulsive ingredients - the "dreck" apothecary - is also part of the Chinese materia medica. Dried salamander, donkey skin, medicinal urines were some of the less appalling constituents; please use your foul imagination for the rest.

Surgery is reported to have generally been outside the domain of China's scholarly medicine, probably due to legal prohibitions on dissection and general reluctance towards mutilation of the body. Nevertheless, forensic medicine was highly sophisticated as evidenced by the *Hsi Yuan Lu*, a codified forensic medicine compilation produced in the 6th century AD. Chinese history provides accounts of surgeons of great skill who performed miraculous operations. But only one surgeon of sufficient prominence has gone down in the history books. Hua T'o, who lived 1800 years ago, is credited with the invention of acupuncture anaesthesia, hydrotherapy, and medical gymnastics. As the story goes, he once successfully treated Kuan Yun, a warlord who was injured by a poisoned arrow. Later, he was called on to treat a nagging headache of Emperor Ts'ao Ts'ao, who, incidentally, hated Kuan's guts. Hua T'o advised trepanation. Just when the procedure was about to begin, the Emperor, in a fit of paranoia , suspected an assassination plot and ordered an on-the-spot execution of the unfortunate surgeon.

In the twentieth century, Chinese medicine was rejuvenated by Chairman Mao who felt that ancient Chinese medicine and pharmacology were great treasure houses that need to be preserved, explored and improved. It was felt that both Western trained doctors as well as traditional healers were needed to take care of the health needs of the rapidly growing population. The "Great Leap Forward" movement launched in 1958 saw the revival of traditional Chinese medicine. Right now, China has a health care system which is considered a model for other developing countries. Principles of medical education and practice have been carefully restructured whereby the physicians and the paramedical staff share diagnostic and therapeutic responsibilities.

Thanks to the foundations laid by the Three Celestial Emperors, the glorious edifice of Chinese Medicine, built over the centuries, has braved the storms of time and has remained largely unshaken. The refurbishment done by Chairman Mao has revitalised the ancient art, which incorporating old knowledge and new ideas will remain for ever as one of the greatest healing traditions ever known to man.

ACUPUNCTURE

The principles

In acupuncture, the skin is pierced by long needles to varying prescribed depths. 365 points have been described along meridians that vertically traverse the body. These are supposed to transmit an active life force called *ch'i* (pronounced 'chee'). This force roughly means a movement, with reference to something that can be understood as energy. The flow of *ch'i* influences one's health and the process of acupuncture is said to obtain and manipulate the *ch'i*, which travels throughout the body via "channels" or meridians. Presumably based on human dissections performed over 2,000 years ago in China, twelve Primary Meridians were described. Two additional meridians were added during the Song Dynasty (c. 1000 AD), making the total number of meridians fourteen.

Picture H. The Chinese character for Acupuncture is made up of characters for Gold and a Needle. On the left, you see the top of the mountain, under which is hidden, between strata of earth, two small nuggets of gold. On the right is a needle with thread passing through it.

The words 'acupuncture point' are derived from the Chinese characters meaning orifice and position (hole position). During the time of the Han Dynasty (c. 202 BC) it was discovered that certain points on the body reacted to the presence of disease. Each of these acupoints is related to a particular organ, but it must be remembered that these do not correspond to the body's nervous system. For instance, a certain spot on the ear lobe may be related to an abdominal organ. The meridians are like rivers flowing through the body to irrigate and nourish the tissues. An obstruction in the movement of these acupuncture energy rivers is like a dam that backs up the flow in one part of the body and restricts it in others. Acupuncture needles remove the obstructions at the dams, and re-establish regular flow. The earliest instruments used for acupuncture purposes were called *bian* which were made out of stone, bone, bamboo, or bone. They have been found to date back to the 17th century BC. Metal needles (iron) were used during the Shang Dynasty rule in the 16th century BC. By the 5th century BC, fine steel needles were being used. During the later centuries, gold, silver, and alloyed metals were used to fashion needles.

Acupuncture is said to work by stimulating the release of endorphins, which are morphine-like peptides in the brain and the natural pain-killers of our body. It is thought that the needles stimulate peripheral nerves, (especially the small myelinated A delta-type III fibres) in the muscles which send messages to the brain to release endorphins. These in turn cause analgesia by blocking the transmission of painful messages. The needles are also supposed to remove blockages allowing *ch'i* energy to flow. Since the needles are very fine, the procedure is virtually painless. However, acupuncture has been found to be effective only in approximately 70 to 80% of humans and animals. It does not work all the time in all people for various reasons. Individuals with high cholecystikinin (CCK) are found to be poor responders to acupuncture analgesia and on the other hand those who respond well have been found to have less CCK.

Moxibustion uses acupuncture principles, points and meridians, but instead of needles, moxa - powdered leaves of the mugwort plant - is placed as a small heap on the patient's skin and burned. This raises a blister and the warmth supposedly increases *yang*. Acutouch is a variant procedure, whereby gentle pressure is applied to acupuncture points to stimulate the related organs. In electrostimulation, electricity of very low voltage is applied to the acupuncture points.

Transcutaneous electrical nerve stimulation (TENS) is a procedure of the West which mimics electrostimulation. The reason why TENS is very much less effective than acupuncture is because it works by using the gate control theory of pain (first proposed by Melzack and Wall) and eventually habituation occurs. Moreover, TENS activates neurones of the skin first and the key A-delta fibres, (which are in the muscle) are not activated. Acupuncture needles activate these small myelinated A-delta fibres which in turn activate selected areas of the brain namely the pituitary, periaqaductal gray neurons in the mid brain and the spinal cord. These three areas are known to be involved in the endorphin mechanism.

The past

Acupuncture was first described by Huang Di "The Yellow Emperor" in China (2696 - 2598 BC) who was the third great emperor of China, but literature records lead us to believe that acupuncture existed even long before that time. Perhaps the clinical application of this science was more carefully studied and documentation initiated during the Yellow emperors reign. The surviving document is the Yellow Emperor's Classic of Inter-

nal Medicine. This Classic text forms the basis for acupuncture and seems to have been the current book of medical care around 2600 BC.

The next significant improvement was in 2006 BC through 202 AD during the reign of the Han Dynasty. Several important books were written at that time. The *Nei Ching*, which was the Yellow Emperor's classic of internal medicine has two parts: *Su-wen* (simple questions) discusses general medicine while *Ling Shu* (spiritual axis) was centers entirely on acupuncture and describes moxibustion as part of acupuncture.

One of the oldest existing texts of acupuncture and moxibustion is a book called *Zhen Jiu Jia Y. Jing* (Comprehensive Manual of Acupuncture Moxibustion) written during the Western Jin Dynasty (265-316 AD), During the rule of the Ming Dynasty, *Zhen Jiu Dei Cheng*, (Great Compendium of Acupuncture and Moxibustion) was written, which serves as a basis for most of the modern acupuncture treatment. In 1671, a Jesuit priest called Harviell, brought acupuncture to Europe via France, when he wrote about Chinese acupuncture in his book "*Les secrets de la Medicine des Chinois, Consitant en al Parfaite Connoissance du Pauls*". Wilen Pen Rhijne, a Dutch East Indian Company fleet surgeon in Japan provided further enlightenment for acupuncture treatment through his book "*Dissertatia de Arthritide*" written in 1683.

Less than a century later - in 1758 - Lorenz Heister, became the first surgeon to recommend acupuncture through his article "*Chiraigeies*". By the year 1820, acupuncture was taught in France at some of the best hospitals. With the French leading the way in European acupuncture, the Dutch and Germans followed suit, as acupuncture received a renaissance in the 1820's.

Franklin Bache, the great grandson of Benjamin Franklin, wrote an article, "Case illustrative of remedial effects of acupuncture" demonstrating the beneficial effects of acupuncture. In 1916, Sir William Osler recommended acupuncture treatment for lumbago in his textbook "The Principles and Practice of Medicine". These gave a transient boost for acupuncture in the United States for a period but however, after the 1920's acupuncture was rarely ever used in the United States for the next fifty years.

In 1971, James Reston, a New York Times reporter in President Nixon's entourage to China, developed appendicitis. The Chinese proposed surgery for his appendectomy using acupuncture anaesthesia which was declined. However, his post operative pain after appendectomy is said to have been relieved by acupuncture at the Anti-Imperialist Hospital in Peking, China.

In that same year, Gray Diamond wrote an article in JAMA, named 'Acupuncture anaesthesia, Western medicine and Chinese traditional medicine', in which he wrote about the experiences in China. Yet, people still felt skeptical about acupuncture. However, in 1973, the New York Society of acupuncture for physicians and dentists was formed and it became the first physician and surgeon organisation in the United States dedicated towards acupuncture. In 1973, The AMA council of Scientific affairs declared acupuncture an experimental medical procedure and the FDA directed that acupuncture equipment be labelled as investigative devices as recommended by the AMA. In 1983, The American Osteopathic Association endorsed the use of acupuncture as a part of the practice of medicine. In 1987, The American Academy of Medical acupuncture was formed as the first national physician and surgeon organisation dedicated to the advancement of acupuncture within America. Since then acupuncture has gained scientific status and recognition and according to a study conducted in 1993, an estimated 500 million dollars is spent every year by the United States public on acupuncture treatment.

The present

Currently acupuncture is a highly specialised science, being taught in premier Universities like UCLA. Physicians are taught traditional Chinese medicine, French energetic, five element, neuroanatomic, auricular and hand acupuncture. These acupuncture treatment systems and microsystems are currently said to be used throughout the United States along with other microsystems including Yamamoto New Scalp Acupuncture and Chinese scalp acupuncture.

According to Feely, acupuncture had a very different paradigm/way of thinking than the Western world. While acupuncture emphasised holistic patterns, relationships, cycles, and processes, the western paradigm emphasised linear thinking, and causality. Therefore, the West could not understand how a needle inserted into the hand could cure a toothache, since the logical and scientific mind of the Western scientist could not fit acupuncture principles into the existing physiological paradigms. This was the main reason why acupuncture couldn't really get a foothold in the West for a very long time.

But now, more and more physicians outside China are using acupuncture to treat many painful conditions especially chronic ones. It is estimated that 5,000 practitioners in Germany, 30,000 in France and 60,000 in Japan use acupuncture along with drugs, nerve blocks and other approaches to treat patients with chronic pain. In the United States alone, it is stated that over 1,000 physicians and surgeons actively practice the art of acupuncture and it is likely that acupuncture will continue to grow attracting more and more physicians as scientists prove by research and evidence, the efficacy and superiority of acupuncture.

Islamic Medicine

In ancient Arabia, a bitter religious dispute existed between two equally despicable characters - Cyril, the Patriarch of Alexandria and Nestorius, the Bishop of Constantinople (now Istanbul). The people, caught between the devil and the deep blue sea, had to flee to Persia and settle there in order to escape the eccentricities of these two tyrannical leaders. Chosroes, the Blessed was gracious enough to grant them asylum and the people started acquiring knowledge by exploiting the works of Hippocrates and Galen, which was further augmented by the knowledge and talents of other refugees and visitors, especially from Buddhist India. Chosroes died in 579 A.D.

Arabian medicine, for many scholars and historians, was synonymous with Arabic medicine since Arabic was the language of the Islamic world. But Arabic texts did not necessarily have Arabic authors; Persians, Jews, Christians and Spaniards played a role in developing Arabic medical literature. The term Islamic medicine represents medical systems and ideas prevalent in the Arabian empire. Like Chinese and Indian medicine, Islamic medicine is still very much alive, being a respected system practised by many a traditional healer.

During Prophet Mohammed's time (569-632 A.D.), Islamic doctrines were established and widely accepted, bringing about the unity of the many scattered tribes in Arabia. It is said that many clinical traditions arose with him, but according to the fourteenth century Arab historian Ibn Khaldun, the prophet's mission 'was to make known to us the prescriptions of the Divine Law, not to instruct us in medicine'. He also said that sincere faith may provide a great advantage for those desire to earn Divine healing and blessing. But according to Magner, the Prophet's general approval of traditional Arab medicine is seen in the collection called the "Medicine of the Prophet", which is a compilation of fragments concerning medical information, extracted from the Holy Qur'an and the *Hadith* which was the 'sayings and doings' of the Prophet. The Prophet himself is said to have advised sensible dietary patterns to prevent disease. The cause of stress as a cause of disease was also known since he declares that "excessive worry makes for physical illness in a person". Honey was considered a natural remedy for several illnesses and the Prophet is seen recommending it in the treatment of certain illnesses. Following the Prophet's death, his followers spread his teachings far and wide across Europe and Asia. Within a few decades, the Islamic empire extended from Spain in the West through Syria and Persia right up to the banks of the Indus in the East and became a force to reckon with by 750 AD. The great empire then split into caliphates, Baghdad becoming one of the key centres of civilisation.

It must be remembered that this was the period where a major part of Europe slipped into medieval darkness and we do not really know much about what happened there during this time. But it was also during this time that Hellenisation of Islamic medicine began, when many ancient Greek and Roman manuscripts of medicine were translated into Arabic. In fact, the period between 750 and 900 AD is known as "The Age of Translations". The Arab conquerors, aggressive as they were in war and conquest, were tame and gentle enough to respect the medical traditions of the nations they vanquished. History books tell us that they were particularly impressed by the school of Medicine in Gondishapur, Persia, which had been founded by a group of Christians under Nestorius. When the Arabs took control over Persia in the 7th century, they reportedly collected every available manuscript and parchment of medicine from the Gondishapur medical school as well as the libraries of every province. These were then translated into Arabic, which became the new vehicle for medicine. The Golden Age of Arabic Medicine extended from 850 to 1050 AD by which time most ancient works had been translated and the knowledge absorbed by the practitioners. Modern medicine thus owes the Islamic world a great deal for helping to purvey classic medicine, by preserving, paraphrasing and passing on ancient medical knowledge and traditions.

Contrary to expectations, most Arabic doctors were Persians, Syrians, Spaniards, Jews, Greeks, Christians or Byzantines, writing in Arabic. Arab doctors - skilled as they were - were also very practical in their approach. "Ask for thy reward while the sickness is at its height" was their maxim. Nepotism was not something unknown since a physician called George Bakhtischu, his son and later his grandson continuously headed the medical school in Gondishapur. Caliph Harun al-Raschid was an ardent manuscript collector and paid heavy premiums to obtain them. In fact, it is said that the Greek manuscripts were his 'most coveted booty' when he conquered the Byzantines. After him, Caliph al-Ma'mun had extensive translations done which were later compared, revised, edited and made into standard text books. He paid the scholars the entire manuscript's weight in gold, which led to translators like Hunain ibn Ishaq honestly make a few extra bucks by using heavy paper and large, bold handwriting.

Hospitals or *bimaristans* were established in all major cities. Cairo had the largest and most famous hospital of the Islamic world. Established in 1286 by al-Mansur Qalawun, it was housed in a former palace and served the rich and the poor alike, without discrimination. It is said to have had the capacity to handle 8000 patients and was complete with a pharmacy, library, lecture halls, a chapel for Christians and a mosque for Muslims. Music was provided to cheer up the patients. Hospital deaths created as much sensation as they do now, since a scan-

dal regarding the death of a patient in a Baghdad hospital resulted in the medical licensing system being reviewed. Not unlike the present day CME programme, doctors were tested if they were up to date in their knowledge. As you may have guessed, 160 (out of the 860 who took the exam) failed to make it!

Even as algebra, astronomy and the numeral system (adapted from India) were getting their refined form, the Arabs - with their admirable knowledge of chemistry - discovered a host of new drugs and started establishing the world's first pharmacies. With the establishment and embellishment of great hospitals and academies in Baghdad, Cairo and other cities, great doctors began to emerge. Rhazes - the man revered as the greatest physician of the Islamic world and one of the most scientifically minded physicians of his time - was one of them.

Rhazes, alias Abu Bakr Muhammad ibn Zakariya Al-Razi (841-926 AD), a musician, songster and a philosopher, took up medicine - almost as a hobby - when he was 40 years old. Arriving in Baghdad from Persia, he set up his practice in a very 'sterile' location. He is supposed to have hung several pieces of fresh meat all over town and later selected the site where the meat showed the least amount of putrefaction! He later becoming totally involved with medicine and eventually his reputation gained him the appointment of physician-in-chief at Baghdad. He was, however, admired for his bedside observational skills and interesting lectures. Rhazes made many practical contributions to medicine, such as animal gut sutures, mercuric compound based purgatives, and tepid sponging. His treatise 'The Diseases of Children' has led some historians to regard him as the father of paediatrics. He was the first to identify hay fever and its cause and did pioneering work on kidney stones. He was also the first to observe and record the pupillary light reflex.

Rhazes wrote accurate descriptions of measles and small pox, drawing from his own personal experiences, which is evident by the tribute paid by the World Health Organization (WHO) in its bulletin dated May 1970, which states: "His writings on smallpox and measles show originality and accuracy and his essay on infectious diseases was the first scientific treatise on the subject." He wrote 237 treatises, of which only 36 have survived. These manuscripts are still extant in the museums and libraries of Iran, Paris, Britain, and Rampur (India). His medical encyclopaedia, *Continens Liber,* brought him a lot of fame. He, however, made the mistake of writing it in one thick volume, since he subsequently incurred the wrath of Prince al-Mansur, who, disappointed with Rhazes' alchemy theories which did not work, ordered that Rhazes be beaten on the head with his own book until one of them broke. The quality of ancient Arabic paper must have been exceptionally commendable, since it was Rhazes' head that broke first rendering him blind (*contre coup?*). It is, therefore, quite understandable why books like Gray's Anatomy were not published until the 20th century!

Rhazes was followed by Avicenna, also known as Ibn Sina, in full Abu 'Ali al-Husayn ibn 'Abd Allah ibn Sina. (Picture I). This Persian, born in 980 AD in Kharmaithen (now in Uzbekistan), was a prodigy even as a kid, and deserves mention in any tale of medicine. Since his father's house was a place where learned men often met, Avicenna was able to profit from the company of the outstanding masters of his day, even from his earliest childhood. Being a precocious child with an exceptional memory, he had memorised the Qur'an and much Arabic poetry by the age of ten and went on to master philosophy, history, poetry, mathematics, law and medicine before he was even seventeen. It was not very long before he entered royal portals to cure royalties of their illnesses. However, he did periodically fall out from royal favour, when he had to move on restlessly from court to court. Though an extraordinary physician, he is known to have had a weakness for the cup.

Avicenna's two most famous works were the *Kitab Ash-*

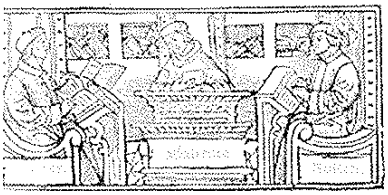
Picture I. Avicenna

shifa (Book of Healing), a vast philosophical and scientific encyclopaedia, and the *al-Qanun* or the Canon of Medicine (with a word count of over a million) - which was a medical bible for several generations right up to the 17th century. It was considered comparable in stature and influence to the works of Hippocrates and Galen, and Avicenna was therefore equated alongside the two earlier doyens (Picture J). Professor Browne, a historian of Arab Medicine considers the work 'systematic, philosophical and reputable' and places Avicenna in the pedestal in par with Aristotle.

In his book, Avicenna describes the contagious nature of tuberculosis, dissemination of diseases by soil and water and advocates the cause for cautery in surgery. He shows amazing knowledge of disease symptoms and pharmacology. However, a great dispute seems to exist whether he was right in classifying love under mental diseases. In *The Inferno,* Dante placed Avicenna side by side with antiquity's two greatest physicians, Hippocrates and Galen (Picture J).

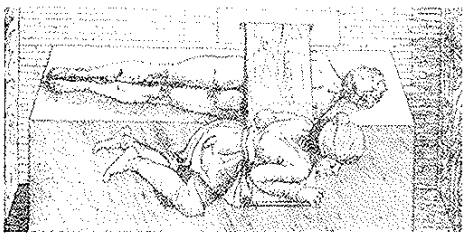
Avicenna is said to have discussed several 'vital' medical problems with his students such as: why hair grows not on the nose; why breasts grow not on the belly; why the stomach lies not behind the mouth and why

calves are not on the front of the legs. Being a gigantic personality himself, he attempted to straighten crooked spines by throwing his weight on a wooden plank placed on the patient's back (Picture K). This apart, Avicenna is described to have used some dramatic grandstand techniques to bring about cures or to demonstrate his point. A woman who complained that she had lost the use of her arms due to a postural defect was proved a fibber when her skirt was abruptly lifted over her head and she hastily pulled it down in a reflex act.



Picture J. Avicenna, Galen & Hippocrates

Brian Inglis, in his book '*A History of Medicine*' narrates an interesting story about Avicenna, who was once called in to treat a young prince who suffered from melancholy and imagined that he was a cow. The hallucinatory prince allegedly went around begging to be slaughtered and made into beef stew. Avicenna, arriving with a knife, examined the 'creature', now bound hand and foot and mooing happily. In his capacity of a 'butcher', he declared the 'cow' too lean and unfit for slaughter. The prince in his eager effort to fatten himself, started eating well, thereby regaining his strength, after which his delusion disappeared. This story summarises, in essence, Avicenna's psychological approach to medical problems and it should be noted that it was the same principle which was rediscovered almost a millennium later, when Freudian psycho-analysts described the technique of entering the fantasy life of a psychotic patient in order to provide a bridge for him to return to reality.



Picture K. Avicenna using his portly physique to straighten a crooked spine. *(From A Picture History of Medicine)*

During the day Avicenna was busy with his duties at court as both physician and administrator, In spite of that, he spent almost every night with his students composing clinical notes and carrying out general philosophical and scientific discussions related to health, patients and medicine. These sessions were often combined with musical performances and gaiety and lasted until late hours of the night.

After several ups and downs in life, Avicenna underwent a period of difficulty that included imprisonment. Even in hiding and in prison he continued to write. Shortly after, he fled to Isfahan, south of Tehran, where he spent the last 14 years of his life in relative peace. Encouraged and esteemed by 'Ala` ad-Dawlah, the ruler, he finished two major works which he had begun earlier and it was here that he wrote most of his nearly 200 treatises. He also composed the first work on Aristotelian philosophy in the Persian language. While accompanying 'Ala` ad-Dawlah to the field of battle during military campaigns, he wrote the masterly summary of his "Book of Healing" called *Kitab an-najat* (Book of Salvation). His last major philosophical opus, *Kitab al-isharat wa at-tanbihat* (Book of Directives and Remarks) was also written during this time. In this work he described the mystic's spiritual journey from the beginnings of faith to the final stage of direct and uninterrupted vision of God. Once criticised by a fellow scholar for lack of mastery in Arabic philology, Avicenna spent three years studying it and produced a vast work called *Lisan al-'arab.* This clearly shows his dedication and thoroughness in academic matters. Avicenna's strenuous academic and administrative activities eventually took its toll and in June 1037, Avicenna died in Hamadan of colic and exhaustion.

The pharmacy was exclusively an Arabian achievement. It developed as an establishment in its own right and complemented the doctor's consulting room thereby relieving the physician the dreary task of compounding his own drugs. By inventing candy coated pills, rose water blended syrups, perfumed mixtures and tantalising tinctures, pharmacists (*saydalani*) made sickness an enjoyable affair. They, however, were shrewd enough to keep their concoctions in unlabeled jars. (Picture L)

Surgery and gynaecology were two areas where significant advances could not be made during this period. Religious taboos which prevented cutting of human flesh - dead or alive - hampered the former, while Islamic modesty (which kept them away from female patients) hindered the latter. Therefore anatomy went into a state of suspended animation and surgery went into a coma, only to be revived by a Spanish born Arab physician known as Albucasis.

Albucasis gave a new lease of life for surgery by reviving cautery methods advocated by his earlier mentors. Branding irons became national instruments to sear wounds, remove cancers, treat abscesses. Flesh cutting was, however, surreptitiously done under the guise of removal of tonsils, polyps and extraction of barbs, but apparently there were no objections.

Arabian doctors had only theoretical knowledge about childbirth since it was mostly only the midwives who were allowed to conduct the deliveries. The doctor, if in attendance, was separated from the patient by a heavy

curtain and prevented from doing any direct examination. An imaginative Albucasis described a position in which the woman in labour lies with her hips at the edge of the table and her legs dangling. This became an instant hit with the midwives who marvelled with admiration at his genius. This position, in modern day obstetric practice, is known as the Welcher's position.

Picture L. A 'smart' pharmacist dispensing medication stored in unlabeled jars.

Avenzoar of Seville (1113-1162AD) was the medical leader of the western caliphate and this man was quite contemptuous about Avicenna and his work *The Canon*, since he is said to have caustically dismissed it as a 'mere waste of paper'. He is attributed to have instituted the concept of a 'nutrient enema' when he injected (per rectum) milk, eggs and gruel into the gut of a patient with throat cancer. The apparatus used - a goat's bladder and a tube. His student Averroes ibn Rushd, the Commentator, was known for his brilliant translation of Aristotle and avid reading skills. The only two instances where Averroes is said to have missed his nocturnal perusals were on his wedding night and when his father died. Moses Maimonides (Musa ibn Maimun), was a Jewish scholar and the court physician of Sultan Saladin. He was a student of Averroes and did many translations of ancient manuscripts into Hebrew and Latin. Avenzoar, Averroes and Maimonides were however less famous physicians of that time, but nevertheless, it was they who carried the torch along before Cordova was captured by Almohades and the Mongols took control of the Eastern part of the empire. Invaluable intellectual treasures were destroyed and scholars and learned men were mercilessly murdered. In the Western part, the Almohades eventually fell before the Christians, but it is said that they absorbed Islamic culture, rather than destroying it, to the benefit of future generations.

As the great sages of Islamic medicine were creating history, contributing to the serious part of this story, we also see some of the quacks providing humour to this narrative. A physician allowed starving vipers to bite his patient suffering from elephantiasis; cure elephantiasis, it did, but nevertheless, induced leprosy, deafness and loss of vision. An unethical physician killed his patient with a poisoned lancet; he was later killed when he unwittingly used the same lancet on himself. Jehangir, son of Moghul emperor Akbar, in his autobiography describes how his aged father had diarrhoea which, with medical treatment, was transformed into dysentery; dysentery was treated resulting in constipation and constipation, thanks to the doctor, turned into diarrhoea once again and finally death. Jehangir rues the day he sought medical attention and declares that "except for God's decree and doctors' mistakes, no one would ever die".

In the nineteenth century, Islamic Medicine came under pressure from doctors practising the Western style of medicine. Claiming that traditional Islamic Medicine had become inert and unproductive, Sultan Mahmud II established a Western style hospital and medical school in Istanbul. French doctors manning the various departments ruled supreme, driving practitioners of traditional medicine underground. Eventually, as a compromise between the two systems, arose a new branch of medicine known as the *Yunani Medicine* or Greco-Islamic Medicine (in Arabic "Yunani" means Greek). The Yunani system was recognised in some countries, but taken up seriously only in India and Pakistan where Yunani medical colleges and hospitals were instituted.

> Well knew he the olde Esculapius
> And Deyscorides and eek Rufus
> Olde Ypocras, Haly and Galeyn,
> Serapion, Razi and Avycen,
> Averrois, Damascien and Constantyn,
> Bernard and Gatesden and Gilbertyn.

The verse quoted above is found in the prologue of The Canterbury Tales, by Geoffrey Chaucer. Rhazes, Avicenna and Averroes feature in this 14th century sonnet simply because Chaucer regarded them among the great medical authorities of that time. When the Roman empire collapsed in the fifth century, Europe lost touch with much of its intellectual heritage. The Latin library was limited to Pliny's Encyclopedia and Boethius's treatises on logic and mathematics and a few other insignificant manuscripts. After collecting ancient manuscripts, Arab physicians translated, augmented and finally codified the classical Greco-Roman heritage that Europe had very nearly lost and laid the foundations of the institutions and the science of modern medicine.

To conclude this narrative, I shall appropriate the words of Arnold and Guillaume to epitomise the grandeur of Islamic medicine which served as a vital link to amalgamate ancient medical traditions with those of modern times:

"Islamic medicine and science reflected the light of the Hellenic sun, when its day had fled, and they shone like a moon, illuminating the darkest night of the European Middle Ages. Some bright stars lent their own light and that moon and stars faded at the new day - the Renaissance. Since they had their share in the direction and introduction of that great movement, it may reasonably be claimed that they are with us yet."

References

1. Yellow Emperors Classic of Internal Medicine translation by Ilza Veith, University of California Press, Berkeley, California 1993.
2. Acupuncture, It works! by Rajen M. Healthcare Today Vol 1; No. 3 1997
3. Historical overview of Acupuncture by Richard A. Feely,
4. Great Moments in Medicine by George A. Bender, Parke Davit 1961.
5. A History of Sanskrit Literature by Arthur Berriedale Keith. Oxford at the Clarendale Press, 1928
6. The Susruta Samhita, by Bhishagratna, K.K.L. Calcutta, J.N. Bose, 1907
7. Indian Medicine by Julius Jolly. Translated into English by C.B. Kashikar, Poona, 1951.
8. A History of Medicine by Lois N. Magner, Marcel Dekker Inc., 1992.
9. The Indian Operation of couching for cataract by Robert Henry Elliot, New York: Paul B. Hoeber, 1918
10. Arabian Medicine by Browne, Edward G., Cambridge, 192.
11. The Legacy of Islam by T. Arnold and A. Guillaume, Oxford University Press, 1931.
12. Medicine - An Illustrated History by Albert S. Lyons and R. Joseph Petrucelli II, Harry N Abrams Inc., 1978
13. Ancient Medical Heritage, Readers Digest, March 1987, p. 96
14. The Arab roots of European medicine by David W. Tschanz.
15. A pictorial history of Medicine by Otto L. Bettman. Charles C Thomas, 1992.
16. A history of Medicine by Brian Inglis. Weidenfeld and Nicholson, 1965.
17. A history of Medicine by Nancy Duin, Sumoon & Schuster, 1992.