

SCIENTIFIC MEDICINE*

by

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PART I

THE DAWN

The Renaissance or age of reformation has been compared to a tree which puts forth fresh buds and blossoms in springtime while the withered leaves of the previous autumn still hang thick upon its branches, and the image may very fairly be applied to the changes which then took place in the healing art.

Withington: *Medical History from the earliest times.*

I have selected for my address an interesting phase of medical history: the first appearance of modern scientific medicine and its early developments, covering roughly, the period 1500—1700. Actually it is one aspect or phase of a movement of tremendous power and vast significance: the Renaissance.

The age of the Renaissance was the transitional period between an old order of things and a new, between the medieval period and the modern. It ushered in a new era in practically every sphere of human thought, human activity and human endeavour. It inspired men to embark on perilous adventures which, because they were conducted not only with courage but also with intelligence, led to the discovery of new sea-routes and a new continent. It witnessed such epoch-making inventions as the printing press, the telescope and the microscope. In the vast domain of the physical sciences it signalized the appearance of new principles and new methods that were destined to change the face of the world. It saw the birth of a new art in its many aspects, plastic, pictorial, architectural, etc., and of a new literature as rich and varied as it was bold in conception. Above all, in that age and under the influence of that movement, human thought was emancipated from the thralldom of a false conception of authority and men came vividly to realize the tremendous potentialities latent in that masterpiece of God's creation, the human intellect.

It was an age of new births, of new life, of new ideas, of new hopes for the future, an age which gave to the world a new type of man and which revealed to men a new and more wonderful universe. It was truly an awakening in every department of knowledge and along every line of study. The invention of printing hastened the dissemination of the New Knowledge. I must, however, confine myself to what the Renaissance did, in particular, for the advancement of the science and art of medicine.

My main task is to set before you some of the glories and splendours of the first appearance of modern scientific medicine. Before I do so, I feel I should answer certain preliminary questions. How is it that scientific medicine was so late in making its appearance? What led to the transformation, and how was the change brought about?

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Western Europe, as we know, first found a place on the map of the world as a part of the Roman Empire. Rome had subjugated and civilized some—though not all—of the barbaric tribes of Europe. But not even Rome could give what she herself did not possess; and Rome had no medicine as she had no science. The Romans left us a lordly literature, but to science they hardly made any original contribution. The only medical work in Latin, that of Celsus, was a magnificent compilation of Greek medicine by a scientific layman. Though not a practising physician, his work is written in elegant Latin and shows much breadth of vision and great technical knowledge. Caius referred to him as “the Latin Hippocrates.”

The only European country in which the sciences, including medicine, as well as the arts flourished was Greece. That little country in the south-east corner of Europe—the inheritor of the culture of Crete, the learning of Egypt and the wisdom of Chaldea—was Europe’s only nursery of science, and therefore of medicine.

After the subjugation of Greece by Rome, Greek culture bade fair to subdue the Roman empire. The peaceful conquest would probably have been achieved in due course had it not been for two occurrences. In 323 A.D. Emperor Constantine built a new capital for himself on the Bosphorous. Before the end of that century the Roman empire was divided into two: a Western empire with Rome as capital, and an Eastern with Constantinople or Byzantium as metropolis. As time passed the cleavage between East and West became more pronounced and Greek thought, learning and language, and Greek influence became more and more confined to the Eastern sector.

Frederic Harrison thus sums up the debt of modern scholarship to Byzantium: “The peculiar indispensable service of Byzantine literature was the preservation of the language, philosophy and archaeology of Greece. It is impossible to see how our knowledge of ancient literature or civilization could have been recovered if Constantinople had not nursed through the early Middle Ages the vast accumulations of Greek learning in the schools of Alexandria, Athens and Asia Minor... if the Scholiasts had not poured out their lexicons, anecdotes and commentaries... if indefatigable copyists had not toiled in multiplying the texts of ancient Greece. Pedantic, dull, blundering as they are too often, they are indispensable. We pick precious truths and knowledge out of their garrulities and stupidities, for they preserve what otherwise would have been lost forever.”

The Western empire on her side was in the two next ensuing centuries overrun by the barbaric tribes of the North, who threatened to sweep away not only the old empire but also every vestige of civilization as well. It was left to the Christian Church to tame the wild men, without breaking their spirit or sapping their vitality and out of the rough and uncouth material fashion a new Europe.

For a time all the learning that the West possessed was confined to the monasteries and ecclesiastical establishments; but the monks and clerics used their time to good purpose by copying and preserving the old writings. In this way the Church tried as best she might to preserve “the legacy of ancient culture in a barbaric world.” Before long, however, from the 6th century at least, schools began to be opened, attached to monasteries and Bishops’ houses. Learning received a great impetus in England under Alfred the Great, and in France and Germany, under Charlemagne.

Meanwhile in the East, sometime after the founding of the Byzantine empire, Nestorius, Bishop of Constantinople was condemned to exile for heresy. He and his followers played an important part in the propagation of the Greek tradition of medicine. When the Nestorians were expelled from Byzantium they moved into Syria carrying with them many manuscripts and a rich medical experience. Edessa became a second Athens. As religious persecution pushed them further East they settled in Gondisapur in Persia which became the birthplace of Arabic medicine. The Nestorians and the Jews translated Greek texts into Syriac and these were retranslated into Arabic. With the closure by Justinian of the medical schools at Athens, Gondisapur and Baghdad became important centres of Nestorian Greek Medicine.

"Under the Abbasides in Baghdad," says Cawadias, "remarkable translations were made of Hellenic writings, of which the Arabian physicians gave various interpretations, without however, adding any original work... The Arabian interpretation of medicine was inferior to the purely Hellenic healing art not only because it was not original but because Greek writers taught, besides facts, a technique of reasoning and observation, whereas the art of reasoning cannot be found among Arabian physicians." With the Flight (Hijra) of Mahomet from Mecca to Medina in A.D. 622, began the amazing conquests of the Arabs. Palestine, Syria and Egypt were soon conquered. They were in possession of Alexandria in 642 and its famous library was destroyed. The Caliph Omar is said to have justified this act of vandalism on the ground that "if these works of the Greeks agree with the books of God, they are useless and need not be preserved, if they disagree, they are pernicious and ought to be destroyed". It is recorded that the volumes kept the 4000 baths of the city in fuel for six months. This legend has, however, nothing to recommend it, as Gibbons tells us that a mob of fanatics some three centuries earlier "had already been fairly thorough in their destructive zeal." It is probable that the Muslims did destroy a large number of the remaining books that contained Christian teaching. They became masters of one half of the world. A Western Caliphate was established with the headquarters at Cordova. "The Crescentade was invincible from the land of the Sphinx to the Gothic Kingdom of Spain." After the followers of Islam satiated their lust for conquest, they developed a great enthusiasm for learning. Lane-Poole says: "No more astonishing movement in the history of civilization has occurred than the sudden passion of the whole Islamic world for culture."

As Miller has eloquently expressed it: "The seat of learning was transferred for a time from the shadow of the Cross to the Empire of the Crescent, from the classic shores of Italy and Greece to the warlike followers of Mahomet, and the fiery descendants of Ishmael." The glory of Athens had passed away years before and little was left of the glory of Rome.

One of the first places where Arabian medicine appeared in Europe is Salerno in South Italy. Here was a medical school which enjoyed great fame in the Middle Ages. No accurate details are available regarding its origin, but a product of this School is the well-known *Regimen Sanitatis*—a handbook of domestic medicine, which according to Castiglioni, "constituted the backbone of all practical medical literature up to the time of the Renaissance."

Here is an interesting passage pertaining to the school of Salerno. The following lines embody the dedication and reveal a glimpse of the contents of the *Regimen Sanitatis* which is supposed to have been the most popular medical work ever written.

*The Salerne Schoole doth by these lines impart
 All health to Englands King, and doth advise
 From care his head to keepe, from wrath his heart,
 Drinke not much wine, sup light, and soone arise,
 When meate is gone, long sitting breedeth smart;
 And afternoone still waking keepe your eyes.
 When mou'd you find your selfe to Natures Needs,
 Forbeare them not, for that much danger breeds,
 Use three physicians still; first Doctor Quiet,
 Next Doctor Merry-man and Doctor Dyet.*

Sir Thomas Elyot in the *Castel of Helthe* (1534) says: "It seemeth that phisicke in this realme hath been well esteemed, sens the whole studye of Salerno at the request of a Kynge of England, wrate, and set forth a compendious and profitable treatyse, called the Govern-
 aunce of Helthe, in Latyne, *Regimen Sanitatis*."

Arabian Medicine

Islamic medicine reflected the light of the Hellenic sun, when its day had fled, and shone like a moon in the Dark Ages. Some bright stars lent their own light, and the moon and stars alike faded at the dawn of the Renaissance, though their influence remains to this day.

M. Meyerhof: *The Legacy of Islam* (1931).

"Before the ninth century had run to its close," says Le Clerc, "the Arabs were in possession of all the sciences of the Greeks; they had produced from their own ranks students of the first order, and had raised among their imitators men who, without them, would have been groping in the dark; and they showed from this time an aptitude for the exact sciences, which was lacking in their instructors, whom they henceforward surpassed."

Although the Arabs were not original thinkers, they left us accurate descriptions of certain diseases. They also advanced the study of pharmacy and the therapeutical use of drugs. They laid the foundations of modern chemistry and pharmacology. Many new drugs were introduced by them; the names of many of these are of Arabic origin, such as alkali, syrup, alcohol, etc.

The Arabs were a keen-witted race, quick to assimilate the culture with which they came into contact; and that they were successful in diffusing this knowledge may be recognized in the well-known portrayal of the Doctor of Physic given by Chaucer in the *Canterbury Tales*:

*Well knew he the old Esculapius,
 And Dioscorides, and eke Rufus;
 Old Hippocras, Hali and Gallien;
 Serapion, Rasis and Avicen;
 Averrois, Damascene, and Constantin,
 Bernard and Gatisden and Gilbertin.*

Avicenna, Prince of Physicians

*Up from Earth's Centre through the Seventh Gate
I rose, and on the Throne of Saturn sat,
And many a knot unravelled by the Road,
But not the Knot of Human Death and Fate.*

Omar Khayyam.

The most famous of all Arabian physicians was Avicenna (980—1037). He is described as an arrogant youthful prodigy who at the age of 18 pompously claimed to be the repository of all knowledge. At the age of 10 he knew the *Koran* by heart and was already writing on medicine at the age of sixteen. He was widely learned in the Greek medical classics. In his *Quantum* or *Canon of Medicine*, which Osler called the most famous textbook ever written, he attempted to codify all medical knowledge. It exerted an influence second only to that of Galen himself throughout the Dark Ages. "Probably no medical work ever written has been so much studied, and is still in current use in the East" (Meyerhof, 1931). Many aphorisms are included in this work: "The body, to be in a healthy state, must have the heart warm, the nerves cold, and the bones dry." "If a patient makes movements with his hands as if picking things off himself, it is a sign of death." He is supposed to have written more than a hundred books. There are some who believe that the quatrains ascribed to Omar Khayyam were really the work of Avicenna and the stanza quoted above may well apply to Avicenna himself. In the words of Le Clerc: "Avicenna is an intellectual phenomenon. Never perhaps has an example been seen of so precocious, quick and wide an intellect extending and asserting itself with so strange and indefatigable an activity." Avicenna was not only a physician, but was also an astronomer, poet, philosopher and statesman.

Rhazes (860—932) was one of the greatest medical men of all time. His contemporaries surnamed him "The Experienced". He gave the first authentic accounts of smallpox and measles which were often confused till then. To quote one sentence: "Excitement, nausea and unrest are more prominent in measles than in smallpox, whilst the aching in the back is more severe in smallpox than in measles." He also published a famous encyclopaedia of medicine known as *Al-Hawi*, the Latin translation of which (*Liber continens*) is said to have weighed over twenty-two pounds. He had a quarrel with the ruler of Bokhara who ordered that Rhazes should be hit on the head with the book. His blindness has been attributed to this incident.

His fame as a physician was so great that he was called from his native place of Raj to take charge of a new hospital that was to be built at Baghdad. He was asked to select the place where the hospital was to be erected. The story goes that in choosing a site, he hung up at many points about the city large pieces of meat and then watched them to see which would be the last to spoil. That place he chose for the site of the hospital, in the belief that the air there was better than at any of the other sites. He, of course, knew nothing of bacteria or infection but he appears to have realized that putrefaction and disease had something in common.

In one of his medical treatises is found this excellent counsel: "Study carefully the antecedents of the man to whose care you propose to confide all you have most dear in this

world,—that is, your life and the lives of your wife and children. If the man is dissipated, is given to frivolous pleasures, cultivates with too much zeal the arts foreign to his profession, still more if he be addicted to wine and debauchery, refrain from committing into such hands lives so precious." Rhazes was a voluminous writer but many of his books have perished.

Avenzoar who was born near Seville in 1113 was the greatest physician of his time and acquired great fame as a practitioner. He is said to have discovered the itch mite and was the first writer to describe cancer of the stomach. He had a sound knowledge of the action of drugs. His chief work, *Theisir* is a treatise on remedies and regimen.

Of slightly later date was Averroes, a pupil of Avenzoar. He was better known as a philosopher than as a physician. His main work, the *Colliget* is a résumé of medical science. It was divided into seven parts. His influence was mainly that of a philosopher. He wrote commentaries on Aristotle so famous as to have gained him the name of "the commentator." He was a staunch defender of Aristotle and his views. He said that Aristotle was "the perfection of truth," and that "his understanding attained the utmost limit of human ability," and that "it may truly be said of him that he was created and given to the world by Divine Providence, in order that we might see in him how much it is possible for a man to know."

Maimonides (1135—1208), a contemporary of Averroes, was a distinguished philosopher and physician. He was born in the city of Cordova of a well-known Jewish family. When Maimonides was studying medicine at Cordova a decree went forth that all Jews, and Christians must accept Islam or leave the country. Doomed to banishment because he would not accept the Moslem faith he wandered to Morocco and then to Cairo where he became physician to Saladin, the first Sultan of Egypt. He wrote the *Book of Counsel*, a treatise on diet and personal hygiene for the benefit of Saladin's eldest son. *Aphorisms according to Galen* contains all that is best in Galen's teaching. His most famous work *Guide to the Perplexed* was an independent criticism of Aristotle's principles. In this he reconciled religion with medicine and showed how each might assist the other. His *Prayer of a Physician* contains these noble sentiments: "Endow me with strength of heart and mind so that both may be ever ready to serve the rich and poor, the good and wicked, friend and enemy,—and may I never see in the patient anything else but a fellow creature in pain." His well-known treatise on poisons was widely read in medieval Europe and was translated into several languages. He was regarded as one of the greatest of Jewish physicians. Feldman (1935) regards him as one of the supreme masterminds in the medicine of the Middle Ages: "His prolific medical output marks him as probably the most eminent and scholarly physician, not only of his own time but of many preceding and succeeding generations." His tomb at Tiberias is still a place of pilgrimage.

Among the Arabs, surgery was regarded as inferior to medicine. One of the most famous surgeons was Albucasis who was born of Spanish parents about the year 936 in Zahra near Cordova. His chief work, *Altasrif* contains a complete account of medicine and surgery. The surgical portion is divided into three parts, one of which deals with the cautery, the use of which was strongly advocated by him. There is also a section containing many illustrations of surgical instruments and appliances. He said that surgical operations are of two kinds, those which benefit the patient and those which usually kill

him. He did much to raise the status of surgery which, in his view, "had passed into the hands of vulgar and uncultivated minds and had fallen into contempt". He states that one of the principal reasons why it is so rare to meet a successful surgeon is that the apprenticeship of this branch is very long and he who devotes himself to it must be versed in the science of anatomy. He gives two illustrative examples where lack of sound anatomical knowledge had fatal results: "I have seen a surgeon incise a scrofulous swelling in a woman's neck; he stuck the knife into the cervical artery, and the patient fell dead in his arms. I have seen another extract a large stone but brought part of the bladder with it; the patient died on the third day." The study of anatomy was prohibited so that anatomical dissection was not practised by the Mohammedans who had to rely on the anatomical descriptions of Galen. The little progress made by surgery is thus explained.

Although Arabian Medicine fell into disfavour at the Renaissance, it had served a useful function by preserving the medical teaching of the Greeks when it was in danger of being lost during the Middle Ages. Inaccurate as some of these translations were, they exercised a dominating influence over the minds of the thinkers of the West from the twelfth to the fifteenth century when "the discovery of the Greek texts and their more accurate translations led to the rise of a school of Hellenists and to a taste for the purer sources of learning." The final act which unlocked the treasures of Constantinople and gave to Europe a full knowledge of Greek learning came in 1453, when (to quote Chaplin) "on that fateful 29th of May Mahomet the conqueror burst through the gate of St. Romanus over the corpse of the valiant Constantine and the Greek Empire ceased to exist after a thousand years of mingled glory and shame."

Up to the end of the fifteenth century, then, European medicine was not scientific because it was based on unproven and often erroneous data and because the spirit animating it excluded all critical inquiry; for such was the veneration in which Greek learning was held by the medievalists that Greek physicians especially Galen were regarded as the supreme authority to be accepted and followed without question or doubt. Even the pioneers of the later scientific age found it no easy matter to believe the evidence of their eyes when it went against the authority of the Ancients.

This reverence for antiquity and the dead hand of authority has, as Bacon said, "retarded men for advancing in science and almost enchanted them." Browning expresses this mental attitude in the familiar passage :

*..... those divine men of old time
Have reached thou sayest well, each at one point
The outside verge that rounds our faculty,
And where they reached who can do more than reach.*

A similar infallibility was ascribed to Aristotle whose assertion of a scientific fact was considered to be the best proof of its truth. Dryden, in his Epistle to Dr. Charleton, pilloried the Aristotelian bogey in these satirical lines :

*The longest tyranny that ever sway'd
Was that wherein our ancestors betray'd
Their free-born reason to the Stagirite,
And made his torch their universal light.
So truth, while only one supplied the state,
Grew scarce, and dear, and yet sophisticate.*

Knowledge cannot be gained by a blind submission to authority but only by the preservation of an open mind and direct appeal to nature.

*Nullius addictus jurare in verba magistri
Quo me cunque rapit tempestas, deferor hospes.*

Horace: *Epistles*

The age of the Crusades brought Western Europe into contact with the ancient East. The men of the West were by that time sufficiently enlightened to appreciate the learning of the Greeks, particularly during the period of nearly sixty years during which Constantinople was occupied by the Franks.

Two courses were thrown open to Western scholars. They could study medicine either in the original Greek or through Arabian translations. A few men, like Robert Grosseteste, Bishop of Lincoln and Chancellor of Oxford University, adopted the former course, but the majority followed the easier way afforded by the Arab versions; and it was medicine taught and studied in the latter way that prevailed. Thus, from the end of the thirteenth century to the end of the fifteenth, European medicine was Arabian—that is, second-hand Greek.

But this second-hand Greek science was not the genuine article. Not only did it lack that "technique of reasoning and observation" which was so characteristic a mark of Greek science but the writings that reached Western scholars through a double or treble process of translation—directly from Greek into Arabic or through Syriac and Arabic into Latin (the scientific language of medieval Europe) contained many errors and distortions to which both translators and copyists had contributed.

Such was the state of affairs when the capture of Constantinople by the Turks in 1453 drove Greek Scholars westward, chiefly into Italy. Wherever they went, they carried with them manuscripts which they saved from the holocaust of Constantinople and in this way they spread the knowledge of the masterpieces of Greek literature and art and enriched Western libraries with Greek manuscripts. The classic past was thus rediscovered. Through these men Western scholars were enabled to detect errors that had crept into hitherto accepted translations and get at the Greek fountain-head of medical knowledge. The results were unprecedented. "First in Italy," says Caird, "and then on this side the Alps, what we call 'the revival of letters,' the quickening of human intelligence by renewed acquaintance with the literature, the philosophy, the civilization of classical antiquity, had stirred up a new spirit of intellectual independence; and as everywhere this spirit grew and gathered strength, the natural result was a struggle with the long unmolested sway of tradition and authority. It was not merely that in the resuscitated treasures of ancient thought men found themselves heirs to a long lost heritage, but that converse with the great writers of former times communicated a new self-confidence to human reason, awakened into new life the suppressed critical instincts, and made that attitude of docile ignorance or spurious intellectual activity which had hitherto prevailed, no longer possible."

In the intervening years, however, medieval Europe had not been intellectually idle. It was treading paths of knowledge undreamt of in previous ages. It had produced a

Doctor Subtilis, a Doctor Admirabilis, a Doctor Angelicus, and a host of other luminaries. It had evolved and developed a system of knowledge—Scholasticism which consisted in applying to Christian doctrine the scientific system of philosophy developed by Aristotle.

“It was the task of scholastic theology and philosophy,” says Lindsay, “to knead into human thought Christian ideas, and among the rest, the idea of the unity and uniformity of Nature. Anti-Christian critics have spoken of the deadness and uselessness of Scholasticism, but its value for science and scientific inquiry can scarcely be overestimated, for it was Scholasticism which worked Christianity into every department of human and intellectual activity, and so leavened them with it that when its work was done the intelligence of man was so saturated with the Christian view of Nature that it could never again forget it. When Scholasticism had accomplished its task, modern science sprang into being, dependent for its very foundations on that Christianity, to which it is supposed to be so bitterly hostile.”

Greek medical science, in its purified form, thus came into contact with the European mind sharpened and made subtle and penetrating in the great medieval universities by the schoolmen. Of this union was born the new medical science, the scientific medicine which we honour by the title ‘modern’. No other explanation of the phenomenon seems possible. The ancient medical science of the Greeks had existed and been known for several centuries. But, both in its own homeland and in the neighbouring countries, it had remained static. Only when it reached Western Europe which had been tutored in the medieval seats of learning, only then did it become modernized, only then did it assume developments and reach heights which the greatest of Greek scientists would not probably have considered possible. It is an undoubted fact that Linacre, Harvey, Vesalius and many others who led the way in evolving the modern scientific system out of the ancient system of the Greeks were products of the medieval universities of the West.

I now come to the main purpose of my address to show how from the ideas and ideals, the toils and labours, the successes and failures of the men of science of the two centuries that followed the fifteenth, the ancient system of medicine evolved gradually, stage by stage, into the specialized science which it is today.

These pioneers of medical science left their mark on their own age and cleared the way for the men of our day and generation. For a proper understanding of the growth of medical science during the sixteenth and seventeenth centuries we must perforce note the achievements of men in relation to the times in which they lived and the concepts which then prevailed. It is also worth remembering that a discovery of today depends upon the labours of bygone generations, so that we cannot fully understand the present without some knowledge of the past. The same idea has been graphically presented by Guy de Chauliac: “The Sciences are created by successive additions, the same man cannot lay the foundation and perfect the super-structure. We are as children carried on the neck of a giant, aided by the labours of our predecessors we see all that they have seen and something besides.”

As the subject is vast I propose to make as it were an aerial flight over these two centuries taking note mainly of the soaring peaks but not actually neglecting the general landscape of the doctrines and theories which then prevailed. Brief sketches of the lives and careers of the leading medical men of this period will, I think, best serve the purpose

I have in view. It would thus be possible to get some idea of their individual contributions to the progress of scientific medicine. But I should like to remind you that medical research was not the sole moving force in these centuries. Honours were divided almost equally among mathematicians, astronomers, physicists, philosophers as well as medical men.

Interaction between Medicine and the other Sciences

It would be interesting, but it would be beyond the scope of this address to discuss in detail the inter-action between medicine and the other sciences. It would also be superfluous to draw your attention to the fact that in every true scientific period the medicine of the age is materially made progressive by science, and vice versa, science is fertilized, activated and advanced by medicine.

Here are a few illustrative examples: William Gilbert, who wrote *De Magne*, the basic textbook on magnetism, was physician to Queen Elizabeth and James I and President of the Royal College of Physicians. The famous astronomer Copernicus whose heliocentric theory "removed" the earth from the centre of the universe, was a medical graduate of Padua. He was a cleric and a Canon of the Church as well. George Agricola, the father of mineralogy who wrote *De Re Metallica*, the first treatise on mining, was a German physician. Galvani, best known as the propounder of the theory of galvanism or animal electricity was a professor of Anatomy at Bologna. The mathematicians Fernel, Cardan, and Recorde were medical men as were the mathematical physicists John and Daniel Bernouilli, the chemists Berzelius and Bertholet and the philosopher John Locke. Edward Wotton, the first English Zoologist and a President of the Royal College of Physicians was also a graduate of Padua. He is the author of *De Differentiis Animalium*—the first printed book on Zoology by an Englishman. He was the first English physician who applied himself specially to the study of natural history.

Leonardo da Vinci, the gifted and versatile artist, made many important discoveries in anatomy as well as in physiology. In *De Homine*, René Descartes (1592—1650) the French Philosopher gave a popular and theoretical account of physiology. He regarded the human body as a material machine directed by a rational soul located in the pineal gland. He taught that mind and matter constituted the universe; that animals had no souls and were mere automata and that man was also a machine but one with a soul which acted along with his body. He regarded conscious thought as proof of the existence of mind and insisted that thought could not be an illusion though nothing else was certain. Huxley indeed says that "Descartes is no less certainly entitled to the rank of a great and original physiologist, in as much as he did for the physiology of motion and sensation that which Harvey had done for the circulation of the blood. The earliest attempts to understand the problem of respiration came from the physico-chemical side—the chemist, Robert Boyle and the physicist, Robert Hooke. Boyle experimenting with his air-pump showed that air was essential to life. Hooke, by a crucial experiment, demonstrated that the main object of respiration is not movement of the lungs but a supply of fresh air. He opened the chest of a dog and after puncturing the lungs he was able to keep the animal alive by blowing a bellows over the opened thorax. The stress which Galileo laid upon mechanics and measurement in science had considerable influence on the evolution of medical thought.

The renowned scientist Herman von Helmholtz was a surgeon in the Prussian army, and Thomas Young, the "father of physiological optics," was the most versatile and

learned physician of his day. Medicine also claims Carl Linnaeus the greatest botanist of all time and Albrecht von Haller who was not only a distinguished scientist but also a man of letters and a famous poet. We have here a whole galaxy of medical men who distinguished themselves in other spheres besides medicine. Later, there were also non-medical scientists who made substantial contributions to the progress of medical science.

Roentgen's discovery of the X-rays revolutionized surgical diagnosis. The zoologist Schaudin contributed to the progress of medical science by his discovery of the *Spirochaeta pallida*, while the Augustinian abbot, Gregor Mendel, supplied medicine with the basic idea in genetics. Pasteur's unforgettable discoveries established bacteriology as a science and gave Lister the idea for his epochal work on the treatment of wounds. Lister indeed spoke the truth when addressing Pasteur, he said, "There does not exist in the whole world an individual to whom medical science owes more than to you."

These examples illustrate the inter-relation and inter-dependence of medicine and the other sciences. Huxley has rightly called medicine the foster-mother of all the sciences. Even Aristotle, the father of the science of natural history, and the greatest collector and systematizer of knowledge produced by the ancient world, had said that "the ablest scientists go back to medicine for their first principles". The most striking example of this we have in Helmholtz of a later day who proved the unquestionable value of medical training in his own special field, that of mathematical physics. He said, "I look back upon my medical studies as the school which taught me, in a more penetrating and convincing way than any other, the eternal principles of scientific work, principles so simple and yet so continually forgotten, so clear and yet ever shrouded by a deceptive veil," and again, "Medicine was the intellectual home in which I grew up and even the emigrant remembers and is best remembered by his native land."

The Scholar-Physicians

The first eminent name in the annals of Medicine in England at this time is that of Thomas Linacre (1460-1524), to whom was due in great measure the revival of Greek thought in England. A Fellow of All Souls College, Oxford, he travelled widely in Italy, visited Bologna and lived for a time at Florence, then almost at the zenith of her splendour. Here a Platonic Academy had been established by Cosimo de Medici. He enjoyed the friendship of Cosimo's grandson, Lorenzo the Magnificent and came under the influence of the famous classical scholars, Poliziano and Chalcondylas. In the eloquent words of Sir George Newman: "Into this beautiful city of flowers, colour and song, there came about 1485 a grave, studious and sober-minded Englishman, Thomas Linacre ... He came out of the shades of scholasticism at Oxford into the sunlight of a larger life and a wider purpose." After graduating from Padua which was then the very *Mecca* of anatomical learning, he delivered lectures on physic and taught Greek in the University. Henry VII selected him as tutor and physician to his son, Prince Arthur. He later became physician to Henry VIII. His association with the Crown and Wolsey's influence with the King enabled him to render the greatest service to English medicine—the establishment of the Royal College of Physicians. This body was empowered "to decide who should practise within the city and a circuit of seven miles around it, and also to examine and license practitioners throughout the Kingdom except such as were graduates of Oxford and Cambridge." The meetings were held in Linacre's own house which he subsequently made over to the College. It is worth remembering that at

this time the licence to practice was in the hands of the priesthood and medicine as a distinct profession did not exist: "There were a few physicians who were often ecclesiastics, a few surgeons and the general practice was done by barber-surgeons and apothecaries." Linacre founded two lectureships on physic at Merton College, Oxford, and one at St. John's College, Cambridge, and this led Henry to create Regius Chairs at these universities. These advantages notwithstanding very little was achieved; since the new learning was simply an authoritarian exposition of the old medicine. The Regius Professors merely read the corrected versions of the writings of Hippocrates and Galen and no attempt was made for fresh observations. Consequently, Caius and Harvey were forced to go to Padua for their medical training. It was Harvey who by introducing the method of experiment revolutionized medical teaching. Linacre is said to have been the first Englishman who understood Aristotle and Galen in the original Greek. He was the most famous scholar and man of letters of his day and one of the most distinguished of the medical humanists who sought "to break Arabian domination and to restore to medicine the uncorrupted spirit of Greece." Erasmus, the famous Dutch scholar who came to Oxford to study Greek with him became a lifelong friend. Erasmus refers to Linacre as "his preceptor and his patron." He also shows his admiration of Linacre as a physician and as a scholar. In one of his letters, Erasmus laments that "no Linacre was at hand to restore him to health by his skilful advice;" in another, "I beg you to send me written out the remedy, which when I was last in London, I took on your recommendation." As regards Linacre's translations from the Greek texts, Erasmus says that Galen speaks better Latin in the translation than he did Greek in the original, and that even Aristotle "displays a grace which he hardly attained to in his native tongue."

In his *Praise of Folly*, Erasmus included this well-known description of Linacre: "I knew an old Sophister that was a Grecian, a Latinist, a mathematician, a philosopher, a physician, and all to the greatest perfection, who after three score years of experience in the world had spent the last twenty of them only in drudging to conquer the criticisms of grammar, and made it the chief parts of his prayers that his life might be so long spared till he had learned how rightly to distinguish betwixt the eight parts of speech, which no grammarian whether Greek or Latin had yet accurately done." Later in life Linacre took Holy Orders. He seems to have done this with a view to obtaining the necessary leisure for his literary work. It was then not an uncommon thing for a learned divine to practise physic and all through his life he never gave up the practice of medicine. He also became famous as a grammarian. Fuller says: "'Tis questionable whether he was a better Grammarian or Physician." Linacre is believed to be the ideal scholar portrayed by Browning in his graphic poem, *The Grammarian's Funeral*.

Back to his book then; deeper drooped his head;

Calculus racked him.

Leaden before, his eyes grew dross of lead:

Tussis attacked him.

"Now, master, take a little rest, — not he!"

Not a whit troubled,

Back to his studies fresher than at first,

Fierce as a dragon.

*So, with the throttling hands of Death at strife,
 Ground he at Grammar;
 Still, through the rattle, parts of speech were rise
 While he could stammer.
 He settled Hoti's business—let it be !
 Properly based Oun,
 Gave us the doctrine of the enclitic De,
 Dead from the waist down.*

Linacre was elected the first President of the College, which he helped to found, and he continued in office till his death from stone in the bladder on 20th October, 1524. Among his contemporaries who shed lustre on Oxford was a galaxy of lesser luminaries of whom I would mention but two, viz. Richard Bartlot and Thomas Bentley both of whom were scholar-physicians well versed in Greek lore and were Presidents of the Royal College of Physicians. There is a classic anecdote about the latter, which incidentally illustrates the high esteem in which Greek learning was held by these scholar-physicians. It is said that when Bentley was an old man, Mrs. Bentley bewailed that he had spent so great a portion of his time and talents on the study of Ancient Greek authors and not on original work. After much thought Bentley gave the following answer: "Child, I am sensible that I have not always turned my talents to the proper use for which I should presume they were given to me. Yet I have done something for the honour of my God and the edification of my fellow creatures. The wit and genius of these old heathens beguiled me, and as I desired to raise myself to their standard upon fair ground, I took the only chance I had of looking over their heads to get upon their shoulders."

John Caius (1510-1573), Fellow of Gonville Hall, Cambridge, was another English student who went to Italy in quest of learning. Whilst at Padua he lodged with Vesalius, the famous anatomist, and it was probably from this association that Caius acquired his taste for anatomy. He became Professor of Greek at Padua. Before returning to England he made a tour of Italy visiting all the most celebrated libraries to collate manuscripts of Galen and Celsus. Like Linacre, Caius was a profound classical scholar. He is said to have been the most learned physician of his age and the most distinguished natural historian of his time. He was court physician during the three successive reigns of Edward VI, Mary and Elizabeth. He was mainly responsible for introducing the study of anatomy into England and was the first probably to teach it which he did in the Barber-Surgeons' Hall, London. He lectured here for nearly twenty years. He succeeded Linacre as President of the College of Physicians, which office he held for nine years. He was most studious in its interests and was the chosen defender of their privileges when the surgeons claimed the right to give internal remedies: "Caius so learnedly defended the college rights and the illegality of the surgeons' practice... that it was unanimously agreed by the Queen's Commissioners that it was unlawful for them to do so." He published an account of that remarkable disease, "the Sweating Sickness," which in that age ravaged the country in a plethora of epidemics. He was an intimate friend of Conrad Gesner, the German Pliny, for whose *Historia Animalium*, Caius contributed articles on rare animals and plants. He is also the author of a quaint volume on British dogs. This treatise found favour with King James who is supposed to have once said, "give me rather Caius's *De Canibus*."

The Scholar-Physicians restored the pure texts of the medical classics which were known only through the distorted medium of Arabic translations. Students of medicine and science were thus enabled to begin anew their investigations, for they could find out what Galen and Aristotle had actually said and whether they were always right. Allbutt (1901) comments: "Aristotle, for example, was now taught in the Schools of the West from a Latin translation of a Hebrew translation of an Arab commentary upon an Arab translation of a Syriac translation of the Greek text." "In this tumult of tongues," says Robinson, "Aristotle had scant opportunity to speak for himself." A spirit of free inquiry and independent thought thus took the place of uncritical respect for the word of authority. But, as Osler said: "In reality, it was not so much that they (scholar-physicians) swept away the impurities in Arabian medicine as that they restored to the profession Greek ideals and again made observation and experiment the Alpha and Omega of the science."

The humanists led the way to the rediscovery of the true meaning and beauty of the ancient world. It is worth recalling here Walter Pater's definition of Humanism: "The belief that nothing which has ever interested living men and women can wholly lose its vitality—no language they have spoken, no oracle besides which they have hushed their voices, no dream which has once been entertained by actual human minds, nothing about which they have been passionate or expended time and zeal."

The Sweating Sickness

The disease first made its appearance in England in 1485 after the battle of Bosworth. Five epidemic outbreaks of the disease occurred in England in the sixteenth century, some of these were very severe and resulted in a very large number of deaths.

Caius's treatise on the subject is the first original contribution to clinical medicine in England. It was written in English but Caius subsequently translated it into Latin. He calls the disease "Ephemera" because it lasted only twenty-four hours. He ascribes it to several causes, chief among them, the "evil diet" of his countrymen, "which destroyeth more meate and drinke, without all order, convenient time, reason or necessity, than either Scotland or all other countries under the sun. Wherefore if Esculapius, the inventor of physick, the saver of man from death, and restorer of life, should return again to this world, he could not save these sorts of men... Those who had the disease sore, with peril of death, were men of wealth, ease and welfare; or if of the poorer sort, such as were idle persons, good ale drinkers, and tavern haunters—the laborious and thin dieted escaped." The suddenness and severity of the disease can be gathered from the account given by Du Bellay, the French ambassador: "One has a little pain in the head and heart. Suddenly a sweat breaks out, and a physician is useless, for whether you wrap yourself up much or little, in four hours, sometimes in two or three, you are despatched without languishing." It is stated that the disease so terrified Henry VIII that "he kept a physician constantly with him, confessed his sins daily and occupied his time with prayers and experiments in nostrums against the sweat."

The following is a parody on the nostrums current for the cure of the pestilence: "Take a pond of good hard penance, and washe it wel with the water of your eyes, and let it ly a good whyle at youre hert. Take also of the best fyne fayth, hope, charyte yt you can get, a like quantite of al mixed together, your soule even full, and use this confection every day in your lyfe, whiles the plages of God reigneth. Then, take both your handes

ful of good workes commaunded of God, and kepe them close in a cleane conscience from the duste of vayne glory, and ever as you are able and se necessite so to use them. This medicine was found wryten in an olde byble boke, and it hath been practised and-proved true of mani, both men and women."

Public Health Administration

This period also saw the beginnings of public health administration in England. Sir Thomas More, the friend of Linacre and Erasmus, was a great public health reformer. MacNalty even considers him a fore-runner of Edwin Chadwick in public health reform. Henry VIII appointed him one of the Commissioners of Sewers. More paid special attention to improve the purity as well as the number of water supplies.

Looking after the water supply appears to have been a much felt need at the time. Newman (1958) states that London had its first piped supply to communal pumps only in 1660 and that bath tubs came into use in private houses also about this time. In the time of Elizabeth, a lady is supposed to have said before dinner: "go to, let wash handes, but let us have our oysters first, for we should be forced to wash again."

More's book *Utopia* is a remarkable treatise on public health administration and in it he advocates many desirable social reforms. He envisages a well-built city with a good water supply; drainage and clean streets; hospitals for rich and poor and isolation hospitals for infectious cases. He was appointed to supervise the health measures to be taken for plague and sweating sickness. He ordered that people infected with the plague should not leave their homes. They were forbidden to keep animals in their houses. Officers were appointed to burn refuse and keep the streets clean.

He was an eloquent orator, an eminent statesman and legislator, Speaker of the House of Commons, Lord Chancellor, a master of English prose and a classical scholar.

Norman Moore (1913) pays tribute to him thus: "His Greek, his minute knowledge of English, his imagination, his wit, his conduct in all relations and parts of life put him above all other sages of the law in England as the most shining example of their profession." He was a life-long friend of Linacre and Erasmus. In a letter to Ulrich von Hutton, Erasmus gives a graphic account of More's beautiful home life. "I should rather call his house a school, or universitie of Christian religion, for there is none therein but readeth or studieth the liberall sciences; their special care is pietie and virtue, there is no quarelling or intemperate words heard, none seen idle, which household that worthy gentleman doth not govern by proude and loftie words, but with all kind and courteous benevolence; everybody performeth his dutie; yet there is always alacratie; neither is sober mirth anie thing wanting."

MacNalty (1945) observes: "If Sir Thomas More had had a wise and discerning master, if that master had given him due authority and powers in administration, England would not have had to wait three hundred years for the initiation of national public health. Instead Henry VIII sent Sir Thomas More to the scaffold."

Linacre and Erasmus were also interested in public health. In a letter written by Erasmus to Linacre, various suggestions are made to counteract the sweating sickness,

viz. better ventilation, the building of rooms so that they are exposed to light and fresh air on two or three sides and the windows to be so constructed as to be easily opened or closed. With regard to food, he suggests that the people should eat less especially of salt meats and that officers should be appointed to keep the streets and suburbs in better order.

Andrew Boorde, one of the physicians of Henry VIII, was also a pioneer in public health reform. Albutt says that Boorde was "perhaps the first writer on sanitation after the passing of Salerno and perhaps the first after Hippocrates to discuss the aspect and health of the dwelling house". He was a man of wayward and adventurous life, but a person of great learning. His love of fairs and revels, however, procured him the sobriquet "Merry Andrew". He had a great sense of humour; he styled himself Andrew Perforatus. He wrote several books, two of the best known being *The Breviary of Health* and *The Dyetary of Health*, both very interesting publications. The former is a handbook of domestic medicine. It contains many remedies of interest, some of them of a very curious nature. For instance, for deafness: "Take the gall of a hare and mix it with the grece of a fox and with black wool instil it into the ears." For squint: "Put nothing into the eye but the blood of a dove." Some of the treatment recommended is very drastic. For itching: "Prepare a good pair of nails to scratch and claw and tear and rend the skin, that the corrupt blood may run out." For quinsy: "Take a little piece of pork or bacon and tie about it a strong thread and let the patient swallow it and by and by pull it out again. Be sure to hold fast the thread and pull it out quickly." To counteract fear, "use merry company and feare nothing but God."

The *Dyetary* is a treatise on hygiene and deals with such things as the choice of a site for a house, sleep, diet in health and sickness, etc. He says: "A good cook is half a physician. The chief physick doth come from the kitchen, wherefore the physician and the cook for sick men must consult together." As regards meals: "Two meals a day is sufficient for a resting man; and a labourer may eat three times a day; he that doth eat oftener liveth a beastly life. Also sundry meats eaten at one meal is not laudable; nor it is not good to sit long at dinner and supper. An hour is sufficient to sit at dinner; and not so long at supper." "Lunatics should have hot meals three times a day, but no wine or strong ale. Their heads should be shaven once a month and they should be kept in a close dark room with a keeper whom they fear."

He recommends people to wash their faces only once a week and to wipe them dry on a scarlet cloth. Concerning sleep: "Seven hours sleep is enough for most men and healthy men should not sleep by day, but if they must do so, let them lean and sleep against a cup-board or else sitting upright in a chair."

"There should be a fire in one's bedroom to purify the air and consume evil vapours, and the windows should be kept closed at night. Sleep on your right side ... with your head high, have a good thick quilt ... and let your night cap be of scarlet, when you rise in the morning, rise with mirth and remember God."

Directions on choosing a site for one's house contain much sound common sense. The site recommended is one where there is plenty of wood and water, and an abundance of fresh air; there should be no "stinking ponds nor corrupt dunghills," in the vicinity.