

SCIENTIFIC MEDICINE

by

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PART II

PADUA

In the 15th century, Padua rose to be one of the great universities of the learned world. You would recall that Shakespeare puts into the mouth of Lucentio in *The Taming of the Shrew*, the words:

*Tranio, since- for the great desire I had
To see fair Padua, nursery of arts-
I am arrived for fruitful Lombardy,
The pleasant garden of great Italy;
. for I have Pisa left,
And am to Padua come; as he that leaves
A shallow plash, to plunge him in the deep,
And with satiety seeks to quench his thirst.*

Governed with great wisdom by the Republic of Venice, Padua in fact became the university town. The university opened its doors to students of all countries and of all religions. Of all European universities, it was the least shackled by empiricism. Facilities were afforded for the pursuit of knowledge in all its branches. The freedom of thought enjoyed by Padua attracted the ablest men from all over Europe. Eager students, especially of medicine, flocked thither to learn from the most celebrated teachers in the world. Montaigne who visited Padua in 1580 gives the low cost of living as another reason why so many scholars and others resided there. Among Englishmen who went to Padua for their studies may be mentioned Linacre, Caius, Wotton and Harvey.

A characteristic feature of the teaching at Padua was that special emphasis was laid on the experimental and quantitative methods of investigation in both the physical and biological sciences; in this way, it was possible for students to gain a firsthand knowledge of "truth at the source." As has been well said: "By the ordering of experiment after a definite plan, discovery is to be guided, doctrine tested, error dissipated, and the succession of natural phenomena ascertained." The appointment of Vesalius as Professor of Anatomy was the beginning of an incomparable era of medicine at Padua. Vesalius was followed by other distinguished anatomists such as Columbus, Fallopius, Fabricius, Gasserius and Spigelius, all of whom have left their impress in the annals of medical science. Sanctorius was professor of medicine at Padua when Galileo was professor of physics. Copernicus and Fracastorius were also contemporaries. As Newman rightly says: "The Paduan school rendered inestimable service in extending the boundaries of learning. Vesalius revealed morphology as the bed-rock of systematic medicine; Fracastorius was the first of the

moderns in the realm of infection and epidemiology. Fabricius was one of the greatest of the early exponents of the elements of physiology and embryology; and Galileo opened the august chapter of the laws of mechanics and physics." These pioneers laid the foundations and inspired a long succession of descendants, among them, the immortal Harvey, the discoverer of the circulation of the blood.

"It was in Padua," says Sir Clifford Allbutt, "that Medicine long degraded or disguised, was to prove her lineage as the mother of natural science and the truth of the saying of Hippocrates that to know the nature of man one must know the nature of all things."

ANATOMY

The scientific revival led to a new interest in Anatomy. The acquisition of an accurate knowledge of the structure of the human body had been hampered all through the ages by the opposition to dissection based on religious and sentimental grounds. The ancient Greeks rarely studied human anatomy. Their dissections were largely confined to animals. The great anatomist Galen used apes and swine and he applied to human anatomy the discoveries he made in the dissection of these. Many errors were thereby perpetrated.

Galen remained for centuries the undisputed authority from whom none dared to differ. He was accorded almost divine honours. Harvey spoke of him as *divinus ille*. To dispute his judgement was considered impious if not positively blasphemous. It is stated that in 1550 John Geynes, a Fellow of the Royal College of Physicians, was threatened with expulsion for daring to question the authority of Galen; and one Dr. Hook was not granted admission for the Licence because he had the honesty to say that he had not read Galen.

Galen was a prolific writer. In sheer volume of writing, he leads the ancient world. Singer observes that if we omit the Corpus Hippocraticum, Galen represents at least five-sixths of all the medical writings surviving from antiquity. His works cover every department of medicine, anatomy, physiology, pathology, medical theory, therapeutics as well as clinical medicine and surgery.

This fixed idea of the infallibility of the master closed the eyes of observers to such an extent that the most important discoveries were allowed to pass by. All stimulus to further inquiry was thus suppressed. What Galen had written was credited with such authority that, as Osler said, "fifteen centuries stopped thinking." Although in the late Middle Ages an occasional dissection was permitted, the study of anatomy, as Mc Murrich says, "became conventionalized into the reading of a translation in Latin of an imperfect summary by an Arab of Galen's teaching."

The actual work of dissection was conducted by a mere assistant whilst the lecturer read the appropriate passages from the book, pointing with a wand to the various structures as they were enumerated in the text. The credit for the revival of dissection is given to Mundinus (1275-1321), Professor in the University of Bologna. He himself dissected and taught directly from the dissected body. He published a treatise on anatomy which till the middle of the sixteenth century was the recognized textbook of the schools. The modern

study of anatomy, however, began with the artists of the period. A renewed appreciation of art went hand in hand with the revival of learning. Artists such as Raphael, Albert Durer, Michelangelo and Leonardo da Vinci took to dissection as they felt that if they were to give real "life" to their art, they should have an accurate knowledge of the structure of the body.

"It is necessary for the painter," says Leonardo, "in order to fashion limbs correctly in the positions and actions they can present in the nude, to know the anatomy of the sinews, bones, muscles and tendons, in order to know in the various different movements and impulses which sinew or muscle is the cause of each movement."

Leonardo was the leading artist who practised dissection. He is said to have made more than 700 anatomical preparations. His drawings were not only accurate in detail but were true works of art. This prompted Ruskin's sneer that Leonardo polluted his work with the science of the sepulchre. He took more than an artistic interest in the work and made many notable discoveries in anatomy. He showed, contrary to Galen's teaching, that the air tubes in the lungs end blindly, and that air does not pass from the lungs into the heart. He made a special study of the heart and was the first to demonstrate the ventricles of the brain. He also performed many physiological experiments. He seems to have understood the general principle of the circulation of the blood and the function of the cardiac valves.

Leonardo stressed the importance of the experimental method in science. Anticipating Boyle, he had demonstrated that pure air was necessary both to burning flames and to animal life. It is on record that Cardinal Luis of Aragon and his secretary visited Leonardo's house in 1517. In the following passage, a glowing tribute is paid to the extraordinary versatility of Leonardo's genius and the excellence of his anatomical preparations: "This gentleman has written of anatomy with such detail showing by illustrations the limbs, muscles, nerves, veins, ligaments, intestines and whatsoever else there is to discover in the bodies of men and women in a way that has never yet been done by anyone else. All this we have seen with our own eyes, and he said that he had dissected more than thirty bodies both of men and women, of all ages. He has also written of the nature of water, of diverse machines and of other matters which he has set down in an infinite number of volumes all in the vulgar tongue, which if they should be published will be profitable and very enjoyable." Whetham indeed says: "If we have to choose one figure to stand for all time as the incarnation of the true spirit of the Renaissance, we should point to the majestic form of Leonardo da Vinci."

It was the verdict of William Hunter that Leonardo was "the greatest investigator of anatomy and physiology in his period. No one since the days of Galen and the Alexandrian anatomists, no one before Vesalius, ever dissected the *human* body with such patient and purposeful zeal and ability."

Although it was Leonardo's intention to publish a great work on anatomy, he had to abandon the idea and it was left to Vesalius, who was only four years old at the time of Leonardo's death, to accomplish the task.

Andreas Vesalius (1514-64) the founder of modern anatomy, was a native of Brussels. He studied at Louvain and later went to Paris to study under Sylvius. He pursued his studies with great energy and enthusiasm. The zeal of Vesalius and his fellow-students often led them to weird adventures. Hallam says: "They prowled by night in charnel-houses, they dug up the dead from the graves, they climbed the gibbet, in fear and silence to steal the mouldering carcase of the murderer; the risk of ignominious punishment, and the secret stings of superstitious remorse, exalting, no doubt, the delight of these useful but not very enviable pursuits." After 4 years in Paris, he went to Padua where at the age of 23 he was appointed Professor of Surgery and Anatomy. Five years later appeared his great work, *De Humani Corporis Fabrica*. It is one of the supremely great books in the history of medicine; it revealed the real structure of man's body. Vesalius said that his book was founded, not on what Galen taught, but on knowledge built up from the cadaver by his own efforts. He actually dissected the human body and made accurate observations. In the preface to his book, he makes a bitter complaint about the decay of all branches of medicine: "Dietetics are abandoned to cooks, the teaching of drugs to apothecaries and surgery to barbers. Professors think it beneath their dignity to take a knife in hand." He said that his teacher never used his knife for any other purpose than to cut his steak. In this work, he disproved Galen's assertion that there were pores in the septum between the right and left sides of the heart: "In considering the structure of the heart and the use of its parts, I bring my words for the most part into agreement with the teachings of Galen; not because I think these on every part in harmony with the truth, but because in referring at times to new uses and purposes for the parts, I still distrust myself. Not long ago I would not have dared to diverge a hair's breadth from Galen's opinion. But the septum is as thick, dense and compact as the rest of the heart. I do not, therefore, see how even the smallest particle can be transferred from the right to the left ventricle through it. When these and other facts are considered, many doubtful matters arise concerning the blood vessels." Vesalius was the first who dared to question the teachings of Galen that had ruled medicine for 14 centuries. He commented: "We are driven to wonder at the handiwork of the Almighty, by means of which the blood sweats from the right into the left ventricle through passages which escape the human vision."

He was no respecter of authority. He is said to have demonstrated and corrected over two hundred Galenic errors and thus revolutionized anatomy; but in doing so, he brought on his head a storm of criticism. His former teacher, Sylvius was indignant and called Vesalius, "an impious madman who is poisoning the air of Europe with his vapourings." "Upon the publication of the *Fabrica*," says Foster, "the pall of authority was once and forever lifted."

Charles V created him a Count Palatine in 1556. In the charter of appointment high praise is given to Vesalius and his work: "By your efforts and zeal for physicians, by hitherto unheard of industry, skilfulness, wisdom and diligence...and by the employment of public dissection of human bodies, and the publication many years ago of your volume, *De Humani Corporis Fabrica*, of such erudition, very true judgment, talent and industry, and so celebrated (it is clear) that hitherto nothing has been composed so eloquent, learned and useful. It is easily and without question the greatest of all books which have been written

about anatomy, and celebrated for its illustrations, so that, as you have witnessed clearly, all students of medicine and the most distinguished professors and famous physicians acknowledge a very great debt to you." Hallam remarks: "If Vesalius was not quite to anatomy what Copernicus was to astronomy, he has yet been said a little hyperbolically, to have discovered a new world."

Portal also eulogizes him in these glowing terms: "Vesalius appears to me one of the greatest men who ever existed. Let the astronomers boast of their Copernicus, the natural philosophers of their Galileo and Torricelli, the mathematicians of their Pascal, and the geographers of their Columbus. I shall always place Vesalius above their heroes. The most important, the primary study, for man, is man, and Vesalius had this object always in view, and has admirably attained it; he has made in himself and his fellows such discoveries as Columbus could make only by travelling to the extremity of the world. The discoveries of Vesalius were of direct importance to mankind: by gaining fresh knowledge of his own body man seems to enlarge his existence, while he is but indirectly affected by discoveries in geography or astronomy."

SURGERY AND MEDICINE

The many discoveries in anatomy did much to stimulate an interest in surgery which was in a deplorable condition. Surgery and surgeons were not in good repute. Thomas Gale (1544) thus describes the surgeons of his time: "In the time of that most famous prince, Henry VIII, there was a great rabblement there that took upon them to be surgeons. Some were sow-gelders, and some horse-gelders, with tinkers and cobblers." Some years later Caius enumerated as among those who practised the art: "simple women, carpenters, pewterers, braziers, soap ball sellers, etc." Some fifty years later, Cotta stated: "It is a world to see what swarms abound in this kind, not only of tailors, shoe makers, weavers, midwives, cooks and priests, but witches, conjurers, jugglers, and fortune-tellers." In France in the 17th century, according to Guy Patin, operative surgeons were: "Booted lackeys,—a race of evil, extravagant cockscombs who wear moustaches and flourish razors."

The dividing line between physician and surgeon was not at this time clearly drawn. The physicians were given the right to practise surgery but the surgeons were not entitled to practise physick although some of them did so. The age of the Tudors was indeed a period of transition. Sir John Simon says: "Apothecary, surgeon, physician, each had a mark of his own: the first, his familiarity with the uses of worts and drugs, the second, his skill for bleeding, bandaging, bone-setting and the like; the third, his book learning, especially in the Greeks and Latins, and often his mastery of at least one occult science; but the apothecary was still a variety of grocer, the surgeon still a variety of barber, and the physician but just ceasing to be an ecclesiastic." The occupation of shaving and trimming beards was united to that of Surgery. In England there were two guilds—that of surgeons and that of barbers. Some of the members of the latter body were barbers who shaved, drew teeth and let blood, while other members did minor surgery.

The barber's pole, striped blue and white, is a striking reminder of this dual connexion. At that time, bleeding was of frequent occurrence and during the operation, there was a pole which the patient grasped. The blue stripe was significant of the blue venous blood and the white stripe represented the bandages used to bind up the wound in the arm.

According to Haggard (1934) the barber-surgeons owed their origin indirectly to two edicts of the Church. In 1092 the Church passed a ruling that monks and priests should be clean shaven. Consequently barbers were trained and kept at the monasteries to serve the clergy. Then in 1163 there came the famous edict forbidding churchmen to perform any surgical operations. So these tasks fell to the barber.

Later the two companies of surgeons and barbers were formally united into a company called the Barber-Surgeons' Company. The barbers were restricted from performing any surgical operations except the drawing of teeth and the surgeons on their part had to abandon shaving and trimming beards. The union of the two guilds was due to the influence of Thomas Vicary. He was the author of the first textbook of Anatomy to be written in English and was the first Master of the United Company of Barber-Surgeons. In France also there were at this time two classes of surgeons; the surgeons of the long robe and the surgeons of the short robe or barber-surgeons. Later these two classes combined to form a common guild.

The third group, the apothecaries had no recognized social status. The apothecary was a mere vendor of drugs and compounder of prescriptions; he had no special training and little knowledge except that which he acquired by experience.

Moyes (1896) writes: "There was no Pharmacopoeia. The apothecaries compounded into appropriate forms the drugs obtained from the wholesale grocer. They dealt also in wares such as snuff, tobacco and sugar. The College of Physicians from time to time appointed four of their number who, after taking oath, inspected the apothecaries' shops to test the purity of the drugs, and with power to destroy, if necessary."

The apothecary was held in small estimate by the public. This can be gathered from the rules and regulations which William Bulleyn laid down for their guidance. Some of these are cited below :

The Apoticarye.

- " Must first serve God, foresee the end, be cleanly, pity the poor.
- " To keep his clean ware close, and cast away the baggage.
- " That he neither buy nor sell rotten drugs.
- " That he neither increase nor diminish the physician's bill (i.e. prescription), and keep it for his own discharge. "That he put not one drug for another in making up prescriptions, without advisement.
- " That he do remember his office is only to be the physician's cook.

“That he use true measure and weight.

“To remember his end and the judgment of God; and thus do I commend him to God, if he be not covetous or crafty, seeking his own lucre before other men’s help, succour and comfort.”

The apothecaries had no separate corporation until James I granted them one in the 13th year of his reign. Some years earlier the apothecaries had been made one corporation with the grocers of London but, as stated before, they were later separated from the grocers and formed into a distinct Company under the control of the College of Physicians. From then on no grocer was permitted to keep an apothecary’s shop.

Shakespeare, in *Romeo and Juliet* gives a graphic description of the starved apothecary’s shop:

*I do remember an apothecary,—
And hereabouts, he dwells,—whom late I noted
In tatter’d weeds, with overwhelming brows,
Culling of simples: meagre were his looks,
Sharp misery had worn him to the bones;
And in his needy shop a tortoise hung,
An alligator stuff’d and other skins
Of ill-shaped fishes; and about his shelves
A beggarly account of empty boxes,
Green earthen pots, bladders and musty seeds,
Remnants of packthread, and old cakes of roses,
Were thinly scatter’d, to make up a show.*

Shakespeare’s portrayal of the apothecary does not appear to represent the typical apothecary of his time. It does not tally with those writers who referred to the coach-keeping apothecaries. Gideon Harvey, for instance, comments on their avarice and keenness on making money at the expense of the patient:

“I have oft seen bills of apothecaries rise to 20 £., and sometimes 30 £., in the time of a fortnight; what is more, I have known an apothecary’s bill so extravagant that the sum at the bottom of his account amounted to the sum of 50 £. in the space of thirty days; when the ingredients of the whole course could not be computed to stand him in forty shillings. But that which sounds worse than all this is, that not long since an apothecary of our suburbs brought in bills for less than three quarters of a year’s physick to nine patients, amounting to 1500 £.”

Chaucer’s picture of the Doctor of Physic is also not very flattering either to the physician or to the apothecary:

*For he was grounded in astronomye;
He kepte his pacient a ful greet deel
In houres, by his magic naturel;
Well coude he fortunen the ascendent
Of his images for his pacient.*

*Ful redy hadde he his apotecaries
 To send him drogges, and his letuaries,
 For each of hem made other for to wynne
 Here friendship was not newe to begynne*

* * *

His studie was but little on the Bible

* * *

*For gold in physik is a cordial;
 Therfor he loved gold in special.*

According to the poet the physician was a man addicted to astrology and magic; in league with the apothecary to make the most out of the patients, avaricious to acquire and eager to keep, and indifferent in religious matters.

The First Epidemiologist

Girolamo Fracastoro or Fracastorius (1488-1553) was the first to enunciate the modern theory of contagion. In his book *De Contagione* which appeared three years after the the *De Fabrica* of Vesalius, he described the three methods of infection, viz. infection by contact, infection by fomites, and infection at a distance. He held that infection was effected by semina or seeds which he believed might be generated spontaneously.

He says: "These seeds are the carriers of the contagion and that they are the first origin of the disease there can be no doubt. It may be considered that the force of the disease lies in these seeds since they have the power to propagate and reproduce their own kind."

In 1530 he published the most celebrated of medical poems, *Syphilis sive Morbus Gallicus*. The poem is a summary of the knowledge of the disease and its treatment. The fabled hero of the poem, Syphilus, a shepherd, was represented as the man to have been first infected with the disease. Fracastorius was also the first to publish a description of typhus fever. He also made the observation that consumption is contagious and that the disease may be contracted through conversation with consumptive patients or through contact with objects belonging to them. He should be regarded as the founder of modern epidemiology.

We come next to Paracelsus (1490-1541) who has been described as "a revolutionist with the imagination of a poet and the fearlessness of a crusader"—the celebrated Paracelsus (otherwise Philippus Aureolus Theophrastus Bombastus von Hohenheim, to cite his name in full) who, to show his contempt for the teaching of the Ancients, burnt in the presence of his pupils the works of the old Masters, exclaiming: "You shall follow me, you Avicenna, Galen, Rhazes, you gentlemen of Paris, Cologne, Vienna and whomsoever the Rhine and Danube nourish; you likewise Athenians, Arabs, Greeks, and Jews, all shall follow me. The latchets of my shoes are better instructed than you all. All the universities, and all the old writers put together, are less gifted than the hairs of my beard and the crown of my head."

He was an egocentric and a bold adventurer whose aim and object was to dethrone ancient medicine and to substitute in its place a brand new one of his own creation. He published a pamphlet in German so that all might understand the reform that he was going to bring about.

"Who is there who does not know," he wrote, "that doctors of today make frightful mistakes and greatly harm their patients? Who does not know that this is due to the fact that they cling firmly to the teachings of Galen, Avicenna, and such men? I, Paracelsus, on the contrary, elucidate with industry and to the great advantage of all who will hear me, from books on the practice and the theory of medicine written by myself. I do not, like other medical authors, make these books up out of extracts from Hippocrates and Galen, but in never ending toil I create them anew upon the basis of experience, the supreme teacher of all things. If I want to prove anything I do not try to do so by questioning authorities, but by observation and trial and reasoning..." He makes a prediction concerning his own works: "Some twenty years after I am dead, both young and old will know what my knowledge was, although at present it suffers discredit. Truth will then bring to light its work; all false medicine will be destroyed and with it all other stupidity, and men will find that in my writings are to be found all the healing powers of both the earth and the heavens."

He was motivated by a spirit of revolt that coloured his whole life. "He set himself in opposition to authority," says Moon, "not merely because it fettered the free development of the human mind and hampered the advance of truth, but simply because it was authority."

*Festus, from childhood I have been possessed
By a fire—by a true fire, or faint or fierce,
As from without some master, so it seemed,
Repressed or urged its current; this but ill
Expresses what I would convey.*

Browning: *Paracelsus*

He demolished established authority and substituted for it independent observation. He applied to medical problems the results of his own observations and experience. He was filled with a sovereign contempt for learning. He boasted that he read no book for ten years. "The human mind," he declared, "knows nothing of the nature of things from inner meditation. Reading never made a doctor, but practice is what forms a physician. For all reading is a footstool to practice, and a mere feather broom." As regards the physician, he said "that which his eyes see and his hands touch that is his teacher." He stressed the need for experimentation. "I admonish you," he said, "not to neglect the method of experiment, but, according as your power permits, to follow it out without prejudice. For every experiment is like a weapon which must be used according to its peculiar power, as a spear to thrust, a club to strike, so also is it with experiments." There is no gainsaying the fact that through him a great stimulus was given to the study of chemistry and pharmacy. The purpose of chemistry he said, was

not to create gold or silver or the elixir of life, but to prepare effective remedies. He held that biological processes were nothing but chemical reactions. He may rightly be regarded as the founder of the Iatrochemical school. He introduced various drugs into medical practice. He did not think that anatomy was of any use, stating that that nothing can be learned from the dead body. The academic career of Paracelsus was a stormy one; but he appears to have been a successful physician. Among his patients were the famous printer, Frobenius and the Dutch scholar, Erasmus. The latter wrote: "I cannot offer thee a reward equal to thy art and knowledge, but I surely offer thee a grateful soul. Thou has called from the shades Frobenius who is my other half; if thou restorest me also thou restorest each through the other. May fortune favour that thou remain in Basel." The writings of Paracelsus are by no means easy to understand. He affirmed that in every organ three principles are present: the combustible (sulphur), the volatile (mercury) and the incombustible (ash), and that disease was due to their mal-adjustment. In place of the humoral theory of Galen, Paracelsus proposed five *entia* as the principal causes of disease. He alleged that all medicines rested upon four pillars—philosophy, astronomy, alchemy, and virtue.

He believed in astrology and spirits. He said that he always carried one in the hilt of his sword. He believed in the weapon ointment for the healing of wounds; he explained its efficacy in a mysterious supernatural force which radiated from the weapon to the wound.

His bombastic speech, the licence with which he attacked the orthodox doctors, his theatrical gestures such as publicly burning the works of Galen and Avicenna, led to his continual persecution and he wandered from place to place, finally dying in Salzburg at the age of forty-eight.

He gave vent to his wrath especially against those doctors who were swayed by monetary considerations:

"You have entirely deserted the path indicated by Nature, and built up an artificial system which is fit for nothing but to swindle the public and prey upon the pockets of the sick. Your safety is due to the fact that your gibberish is unintelligible to the public, who fancy that it must have a meaning, and the consequence is that no one can come near without being cheated. Your art does not consist of curing the sick but in worming yourself into the favour of the rich, in swindling the poor, and in gaining admittance to the kitchens of noblemen of the country. You live upon imposture, and the aid and abetment of the legal profession enable you to carry on your impostures and to evade punishment by the law. You poison the people and ruin their health; you are sworn to use diligence in your art, but how could you do so as you possess no art and all your boasted science is nothing but an invention to cheat and deceive ?

"You denounce me because I do not follow your schools, but your schools can teach me nothing which could be worth knowing. You belong to the tribe of snakes, and I expect nothing but poison from you. You do not spare the sick; how could I expect that you would respect me, when I am cutting down your income by exposing your pretensions and ignorance to the public."

Few men there are of whom so much good and so much evil has been written as of Paracelsus. Withington calls him "a mere trumpet-blower," and Bayon, "a rude circuitous obscurantist," while Park looks upon him as "the most colossal figure in the collection of medieval charlatans and knaves." "It is almost as difficult," says Berdoe, "to discern where the charlatan ends and the dupe begins." Jaffe, on the other hand, regards him as "a real benefactor of mankind who did for internal medicine what Vesalius did for anatomy," but the highest praise comes from Garrison who states that Paracelsus was the most original thinker of the sixteenth century. This opinion was more than confirmed by his biographer who writes: "Paracelsus was the fore-runner of all scientific progress from the sixteenth to the nineteenth century. He needed no guidance from his contemporaries, above whom he towered. He refused to be blinded by the dust of ages which they held sacred. He dared to denounce it as a rubbish-heap and to look at God's creation with vision undiminished by its sophistries, its phantasms, and its mendacities. The man who today, from the vantage ground of modern science, describes a new horizon is acclaimed, and justly with world-wide homage, but this man, who cleared the way and who refused to be smothered or cowed by the din his iconoclastic genius roused, was persecuted to his last moments. "We," he might well have cried, "who make sport for the gods are hunted to the end." "As Guthrie says: "He is a mystery and an enigma, he has been misinterpreted and misunderstood, nevertheless he will always remain one of the great figures of medical history." Browning praised his courage and single-minded search, in his poem *Paracelsus* :—

*But after, they will know me. If I stoop
 Into a dark tremendous sea of cloud,
 It is but for a time ; I press God's lamp
 Close to my breast ; its splendour, soon or late
 Will pierce the gloom ; I shall emerge one day.
 You understand me : I have said enough.*

Jerome Cardan (1501-1576). Of this interesting figure (a remarkable combination of intellect and credulity), Hallam says: "His genius was quick, versatile, fertile and almost profound; yet no man can read the strange book on his own life, where he describes or pretends to describe, his extraordinary character without suspecting a portion of insanity." He believed that he enjoyed the friendship of a demon who by marvellous signs warned him of perils; he himself saw and heard things never heard or seen by any other man. "Who would suppose," says the Italian historian Tiraboschi, "that such a man was at the same time one of the profoundest and greatest fertile geniuses that Italy has produced and that he made rare and precious discoveries in mathematics and in medicine." At the age of 19 he was sent to the University of Pavia and subsequently to Padua. Early in 1526 he took his degree as Doctor of Medicine. He practised medicine in various places until he was 33 when he became professor of mathematics at Milan. His growing reputation as a teacher of mathematics injured his practice as a physician. He published a medical work, *On the methods of healing now in use*. The book provoked the hostility of the Faculty as it was a criticism of the work of his fellow-practitioners.

He was excluded from the College of Physicians at Milan on account of his illegitimate birth but a Milanese senator whose son he cured, procured him admission into the Medical Body.

In 1539, he published his *Practice of Arithmetic*, a work of great merit. His classic work on Algebra was published in 1545. He may rightly be regarded as the founder of the Higher Algebra. Two years previously he had published his celebrated treatise on Astrology. As a believer in astrology, he was on a level with the learned men of his time. One cannot but be amazed at the fecundity of his intellect and his lively imagination. Adams comments: "The brilliant mathematician, who could so cleverly reason out the most complicated problems on algebra, lost himself in discussions upon cheiromancy, dreams and omens, ghosts and astral influences. There was scarcely anything which he was not ready to believe. The slightest incident he accepted as a basis for a forecast of the future, with which he concerned himself a great deal more than he did with the present." His great medical work, the *Commentaries on Hippocrates* which he himself considered to be the ripest outcome of his intellect appeared in 1546, and in the following year for the benefit of his children he drew up a compendium of proverbial philosophy, *Libellus Praeceptorum* which contains much sound advice :

"Study most your way of life, for that lies at the beginning of all things."

"Never deliberate when the mind is disturbed."

"Never giggle ; laughter abounds in the mouths of fools."

"You will know wise men by their works, not by their words ; fools you may may know by both."

"When you are on the road, think of the road and nothing else."

"Dismiss all anxious thoughts when you retire to bed."

"Say little : among many words some are imprudent."

"Great prudence and little wit are better than great wit and little prudence."

His most popular work *De Subtilitate* appeared in 1551 ; it is a sort of household encyclopaedia dealing with all manner of subjects. This was followed some years later by a treatise *De varietate rerum*.

Cardan had by now acquired great fame and about this time he was requested by William Cassanate, physician to the Archbishop of St. Andrew's, to see that illustrious prelate who was supposed to be suffering from consumption. But after studying the case for some time he pronounced the illness from which the archbishop was suffering to be asthma and prescribed a course of treatment. The archbishop made a rapid recovery. Bishop Burnet writes : "Cardan cured him of his disease, but being a man much conversant both in astrology and magic, as himself professed, he told the archbishop that though he had at present saved his life, yet he could not change his fate ; for he was to die on a gallows." The archbishop was hanged at Stirling for high treason in 1571. In his journey through England he waited on King Edward VI and was entertained by him. Whilst at the English Court, Edward was solicitous to retain him in England but Cardan refused and returned to Milan where he resided till 1559.

He experienced some severe domestic troubles in his later years. His misfortunes arose from the crimes and calamities of his sons, one of whom was an utter reprobate while the other poisoned his wife for which crime he was executed. Cardan struggled with his afflictions as best he could. He says : "In the bearing of adversity, my nature is not so firm and I have been compelled to endure some things that were beyond my strength. I was much relieved by weeping when the tears would come, though very frequently they would not."

Cardan left Milan for Pavia where he held the professorship of medicine till 1562. Later he left for Bologna where too he was professor of medicine till 1570. In that year, he was thrown into prison upon an accusation of holding impious or heretical opinions. Some of the cardinals interceded on his behalf. He was ultimately set at liberty but was forbidden to publish any more books and was requested to resign his professorship. His friends having procured for him a monthly pension from the Pope, he left for Rome where he died in 1576 at the age of 75. He devoted his time in Rome to the completion of his book *De Vita Propria* which along with a companion treatise *De Libri Propriis* is the chief authority for his biography. Cardan published many books. He wrote extensively on philosophy, mathematics, medicine and cheiromancy. "He was too fond of mysticism, too credulous, too superstitious and, in a word, too much of an astrologer, to be a true philosopher" (Chalmers, 1813). Leibnitz said of him : "notwithstanding his faults, Cardan was a great man and without his defects would have been incomparable." Guthrie summarizing Cardan's contribution to medicine, states : "He made no great discovery on medicine and he was an empiric physician. Nevertheless, like John Hunter, by his collection of facts and clarifying of ideas, he made the path of investigation easier for others, and he well deserves to be more fully acknowledged as one of the great Renaissance doctors."

The history of this period will not be complete unless a brief reference is made to the life of Cornelius Agrippa (1486-1536), a profound student of what is known as Occult-Philosophy which is a strange jumble of astrology, cabalism and magic. The cabalistic theory, in short, is that all the events of life and all the phenomena of nature proceed from influences which gods, devils or the stars exercised on the essential spirit or substance. In a letter written by Agrippa, we find a passage which throws light on his studies : "We conferred much about chemical matters, magic, cabalism and other things which at the present time lie hidden as secret sciences and arts."

Hallam speaks of him as "having drunk deep at the turbid streams of cabalistic philosophy and characterizes his book on *Occult Philosophy* as a rhapsody of wild theory and juggling falsehood." Dampier (1948) says : "It is impossible to trace a tithe of the enormous and intertwined tangle of astrology, alchemy, magic and theosophy which enmeshed the Middle Ages." Never were there seen so many sorcerers, astrologists and alchemists; never were prophecies, visions and prodigies so common.

Agrippa, early in life, was in the service of Emperor Maximilian I. He acted at first as his private secretary, but later, with that monarch distinguished himself in the army by such bravery as to receive the honour of knighthood. He later began the study of law

and medicine, and at the age of twenty took the degrees of Doctor of Laws and Doctor of Medicine. He was a man of extensive genius and skilled in many branches of knowledge but his restless spirit and intemperate pen involved him in so many quarrels that his life became a series of adventures. He quarrelled with the monks who suspected his orthodoxy and became their life-long enemy.

To gratify Margaret of Austria, he wrote a treatise *On the excellence of women* but it was not published, it is said, for fear of the monks. He delivered lectures at different places and on different subjects.

He became a vagabond and almost a beggar in Germany and Switzerland and then went to Lyons where the Queen, mother of Francis, made him her physician. He soon lost favour here and was banished. It is said that the Queen asked him to consult the stars as to what success would attend the affairs of France and he replied that he would not encourage such idle speculation. Then he went to the Low Countries where he was imprisoned. His treatise on *The Vanity of the Sciences* greatly enraged his enemies as he ridiculed the follies of the learned, and his *Occult Philosophy* was considered irreligious and blasphemous. After nearly a twelve months' detention, he paid a visit to the Archbishop of Cologne to whom he had dedicated his *Occult Philosophy*. Creditors began harassing him for his debts and so he betook himself for safety to Bonn. Later he returned to Lyons where he was imprisoned for a libel against the Queen mother. On being set free, he went to Grenoble where he died the same year.

Agrippa has been accused of having been a magician and sorcerer and in league with the devil. Much legendary fiction has grown about him, no doubt invented by his enemies. But the most gruesome and at the same time amusing story associated with his name is the following related by Adams :

“ On one occasion, Agrippa, being about to depart on a long journey, entrusted the key of his study at Louvain to his wife, with a strict injunction that no one should be allowed to enter it during his absence. The lady herself obeyed her husband's order, for she was unaffected by the usual feminine failing of curiosity ; but a young student, who lived in the house, could not rest until he had penetrated into the sanctuary, in the hope of discovering some of the arcana of the philosopher's stone, and employing to good effect his flattering tongue and easy manners, he wheedled out of her guardian-hand the keys. Breathlessly, and on tiptoe, he entered the mysterious chamber, when his gaze at once rested on a large grimoire, or book of magical spells. Seating himself, he began to read, and at the first word, he heard a rapping at the door. He listened, but as it was not repeated, supposed that his imagination had deceived him, and returned with eager eyes to the enchanted page. Another knock so startled him that he sprang to his feet, and with stricken tongue and nerveless lips endeavoured to say : ‘ Come in ’. The door was thrown wide, and into the room strode a stranger of stately bearing but indignant countenance, who, in a harsh voice, inquired why he had been summoned. ‘ I did not summon you ’, faltered the terrified student. ‘ But it was so ! ’ exclaimed the stranger ; ‘ and the spirits of the nether world

may not be summoned in vain.' The student stood speechless ; and the demon, wroth with the presumptuous youth for uttering the word of invocation, clutched him by the throat, and strangled him.

"When Agrippa, after a few days' absence, returned home, he found a legion of devils in possession of his house. Some bestrode the chimney pots, and made the wildest gesticulations ; others played at leapfrog on the parapet, others grinned through the casement windows. Inside, they tumbled head foremost down the stairs, and thronged his study in such numbers that he with difficulty made his way to his desk. Finding the book open, and the student dead on the floor, he knew immediately what had happened, and having with suitable incantations, dismissed the inferior spirits, he reproached the principal demon with his rash and unnecessary cruelty, and ordered him to resuscitate the unfortunate youth, and walk with him in the market-place throughout the afternoon. The demon sullenly obeyed ; and the strange couple went to and fro, apparently a couple of attached friends, in the sight of all the people. But at sunset the body fell to the ground, cold and lifeless, and the crowd removed it to the hospital, everybody believing that the young man had been smitten with a fit of apoplexy. The demon of course had disappeared-it was afterwards affirmed, in a cloud of fire and smoke. Public suspicion was excited ; the magistrate instituted an inquiry, and the result was that Agrippa was ordered to leave Louvain without delay, the townsfolk objecting to the presence among them of a man who was on such intimate terms with demons, and with demons of so decidedly dangerous a character."

Jean Fernel (1497-1558), who has been surnamed "the modern Galen," was the greatest physician in Europe at this period. He was physician to king Henry II of France and in the midst of a very extensive practice composed a great work, *Universe Medicina* which remained the chief textbook of the medical faculties of Europe until the end of the seventeenth century. Although at this time Medicine and Astrology were inextricably intertwined, Fernel omitted all mention of astrology in his book, to the great surprise of the Faculty in Paris who thought it reactionary and indeed presumptuous "to eschew help from the stars which had been arranged for that purpose by a beneficent deity."

He was a skilled anatomist who influenced Vesalius and he was also the first to formulate the science of physiology as a necessary introduction to medicine. He thus cleared the ground for Harvey. Sherrington called him "the John the Baptist of Physiology and Medicine."

He rendered great service to his own and succeeding generations as may be gathered from the following statement : "As for myself, I shall never believe I have profound knowledge of any affection if I do not know positively, just as if I could see it with my eyes, in what part of the human body is the disease, its primitive seat, what suspicion of organic lesions constitute it, whence it proceeded, if it exists idiopathically or by sympathy, or if it be kept up by some exterior cause. He who pretends to be a rational physician must sound each of these subjects, and discern them by certain signs."

Ambroise Paré (1510-90). The wars of the 16th century did much to develop surgical experience and knowledge. Among those who most contributed to the development of surgery during the period was the Frenchman Ambroise Paré. He was born of poor parents about the year 1510. The first part of his life was spent as an army surgeon during the wars between France and Spain, the latter portion was passed in Paris during the civil war which proved so disastrous to the Huguenots. He was chief surgeon to Henry II, Charles IX and Henry III, a fact which earned the witty remark that the kings of France transferred Paré to their successors as a legacy of the crown.

Through his own industry and ability he rose to be the greatest surgeon of the Renaissance and one of the greatest surgeons of all time. He made several original and valuable contributions to surgical literature. He was the first to declare that gunshot wounds were not poisonous and that treatment with burning oil was not necessary.

Paré relates his first experiences in treating wounds by the method then in vogue : " Now all the soldiers at the Chateau, seeing our men coming with great fury, did all they could to defend themselves and killed and wounded a great number of our soldiers with pikes, arquebuses, and stones, whereupon the surgeons had much work cut out for them. Now I was at that time an untried soldier ; I had not yet seen wounds made by gunshot at the first dressing. It is true that I had read in Jean di Vigo that wounds made by firearms were poisoned wounds, because of the powder, and for their cure he commands to cauterize them with oil of elder, scalding hot, in which should be mixed a little theriac ; and in order not to err before using the oil, knowing that such a thing would bring great pain to the patient, I wished to know first, how the other surgeons did for the first dressing, which was to pour oil as hot as possible into the wounds, of whom I took courage to do as they did. "

Paré mentions that on one occasion his supply of oil having run out he was forced to apply on some of the wounded a salve composed of yolk of eggs, oil of roses and turpentine. He says that he could not sleep that night as he feared that the wounded whom he had treated with the salve would be " dead or empoisoned, " but to his great surprise he found them the next morning much better, having rested fairly well during the night, whereas those who had been treated with the boiling oil were in great pain and their wounds were much swollen. The success of the treatment with the salve made Paré exclaim : " Then I resolved with myself never more to burn thus cruelly poor men wounded with gunshot. " It took a man of courage to depart from a course of treatment that had been so rigidly prescribed for centuries.

Paré reintroduced the simple ligature in place of the actual cautery to arrest haemorrhage and was the first to use the ligature in amputations. He tells us that he had been meditating upon the subject for sometime and felt that since ligatures were successfully applied to bleeding vessels and recent wounds, there was nothing to prevent their being equally well applied to amputations. An opportunity soon presented itself when an officer had his leg crushed by a gunshot. Paré amputated the leg and used ligatures to control the haemorrhage. In speaking of the successful outcome of this case, Paré said with great modesty : " I dressed

his wound, and God healed him. He returned home gaily with a wooden leg, saying that he had got off cheaply without being miserably burned to staunch the bleeding." He possessed the true scientific spirit. "For my part I have dispensed liberally the gifts that God has conferred upon me, and I am none the worse for it, just as the light of a candle will not diminish, no matter how many come to light their torches by it."

Paré also made a notable contribution to midwifery by his introduction of podalic version into obstetrics. Paré lived to a ripe old age and died in 1590 at the age of 80. As Miller says: "By applying his great common sense and clear thinking to the evaluation of his enormous experience, Ambroise Paré did more to rid medicine and surgery of the dead wood of past ages than all the other men of his generation excepting possibly Vesalius. In fact Paré with his high type of mind, inventive genius and rare personal charm was a man of whom any generation might be proud." He has rightly been called "the Father of modern surgery."

Sanctorius (1561-1636), Professor of medicine at Padua, laid the foundation of the science of metabolism. He described a clinical thermometer for taking the temperature of the body and a pusilogram or pulse clock for comparing the rate of the pulse. Both these he modified from devices suggested by Galileo. His most famous creation, however, was a weighing-chair—a chair attached to a balance in which he could both eat and sleep and so was able to test his weight under various conditions. He proved that the body loses weight by mere exposure and he referred the loss to insensible perspiration. Sanctorius is said to have spent 30 years of his life in weighing himself three or four times a day. He laid the foundation of the modern science of metabolism. He applied the methods of physics to medical investigations. It was no doubt from Galileo who was his contemporary at Padua that Sanctorius conceived the idea of applying exact measurement to investigate the functions of the body. He thus initiated a new method of inquiry which was to prove of great benefit to later investigators.

Haggard (1934) comments: "The methods that Sanctorius used are by modern standards crude indeed, but the principle of these methods is the same as that used by the physicians of today on the most refined procedures of modern science."

William Harvey (1578-1657) was born at Folkestone. After attending Caius College, Cambridge, he went to Padua in 1598. Here he came under Fabricius, one of the successors, of Vesalius. He remained in Padua till 1602 and after taking his degree returned to England. The same year he proceeded to the degree of Doctor of Medicine at Cambridge. He married, in 1604, the daughter of Dr. Browne, Queen Elizabeth's physician, settled down in London and engaged in practice. He later became a Fellow of the College of Physicians and Physician to St. Bartholomew's Hospital. He was appointed Lumleian Lecturer in 1615 and continued in this post until his resignation in 1656.

In 1618, Harvey was appointed Physician to Charles I. King Charles was interested in Harvey's researches and always treated him with distinguished favour. He remained faithful to the King during the civil war, but he does not appear to have taken an active part in the political struggle at the time. He was present at the Battle of Edgehill and it is said that he had charge of the two young princes. Harvey's second great work *De Generatione Animalium* appeared in 1651. One chapter in this book, entitled *De Partu* is devoted to obstetrics. This is the first original work in midwifery. In 1654 he was unanimously elected President of the Royal College of Physicians, but Harvey refused the honour as he felt that the "concerns of the College were too weighty to be entrusted to one like him laden with years and infirm in health." Harvey died in 1657 in his eightieth year.