

The Harveian Oration

ON

THE DEBT OF SCIENCE TO MEDICINE.

DELIVERED BEFORE THE ROYAL COLLEGE OF PHYSICIANS
OF LONDON ON ST. LUKE'S DAY, OCTOBER 18TH,

BY

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MR. PRESIDENT AND FELLOWS OF THE COLLEGE,—More than two centuries and a half have passed since the most illustrious of our Fellows founded the Festival which we celebrate to-day, and directed that an oration should be delivered by one of our number. Upon the long list of Harveian Orators are many names familiar wherever medicine is studied, and amongst them those of my six most recent predecessors in my chair. I esteem it a great honour that you, Sir, should have thought me worthy to stand here to-day, and to deliver Harvey's message.

It will be my endeavour to follow the injunctions which he laid down: to commemorate the great men of the past, benefactors not only to this College but to the human race; to exhort our brethren to work together in peace and amity, and to urge them to pursue the study of our science, by methods of which he himself made such good use.

Ever since this College was founded its Fellows and Members have, generation by generation, brought their several stones to the building of the house of medicine. Upon its Roll are names of "men in their generation famous, and in ours never to be forgotten," men of genius whose fame as discoverers and as pioneers, in medicine and in other branches of natural science, is world-wide and will never die; and of some highly distinguished in other walks of life, great scholars, such as Linacre and Caius, poets and philosophers. Upon it, too, are names of generous benefactors to scientific education, such as John Radcliffe and Matthew Lee, and of commanding personalities, patrons of science, art, or letters, such as Richard Mead, the Mæcenas of his day.

But these great ones form only a small minority, and most of those upon our lists were men of lesser stature; but as teachers who handed down to their pupils the treasures of their observation and experience, busy practitioners, keen observers, or men of varied culture, few of them can have failed to add something to the sum of human knowledge. Yet many of their names recall no memory, or have attained to that most arid form of immortality, to serve as labels for malady or symptom. But, collectively, the work which they did counts for much, and those of us who are conscious that we shall leave no "footprints on the sands of time" may take courage from the thought that we too are helping to do the spade work for some future Harvey.

On this occasion it is only fitting that special mention should be made of one born just three hundred years ago, and who, although, owing to a technical obstacle now long obsolete, he was not a Fellow of this College, held its licence; and we may associate in our celebration the names of William Harvey, the physician to King Charles and the immortal founder of modern physiology, and Thomas Sydenham, the soldier of the Parliament, who did for clinical medicine what Harvey did for physiology, and brought it back from the realm of fancy to the bedside study of signs and symptoms. These two men, Harvey and Sydenham, each pre-eminent in his own line, were wholly unlike in their outlook, and although contemporaries are not known ever to have met.

Sydenham, at the mention of whose name the illustrious Boerhaave used to raise his hat, has been called the English Hippocrates, and by this College, on his monument, "Medicus in omne ævum nobilis." Certainly no man ever had, in greater degree, the gift of conveying, in

a few sentences, a vivid picture of a morbid state, and even though we may rejoice that those dear to us are no longer treated in accord with his prescription, we realize that he opened a new era of therapeutics. To him must be assigned a high place among our benefactors.

The history of medicine traces back to the birth of our race, and even beyond, for we know that the lower animals have therapeutic instincts. From the outset treatment has been shaped by prevalent notions of the nature of disease, and maladies provoked by the enmity of a primitive deity, or by the malicious magic of a fellow creature, are only likely to be cured by magical methods. In Osler's words: "To a very definite but entirely erroneous pathology, was added a treatment rational in every respect, had the pathology been correct." The primitive medicine and the art of the medicine-man survive to this day among the savage races of the earth, and he would be a bold man who should deny their survival amongst those races which regard themselves as the highest products of civilization. Are any of us wholly free from such ideas?

For ages medicine has striven to shake off her bonds, and to attain to the status of a science. The first act of the drama was staged in ancient Greece. We know well that the true spirit of inquiry, the desire for knowledge for its own sake, was innate in that wonderful race, of which the intellectual life centred around the city in which the people "spent their time in nothing else, but either to tell or to hear some new thing." The legacy of Greece embodied not only the Parthenon and the Erechtheum, the sculptures of Pheidias and Praxiteles, the plays of Æschylus and Euripides, the thoughts of Socrates and the works of Plato. Greece gave us also Aristotle and Hippocrates. Only the true spirit of science could have prompted the minute and accurate research into the structure and functions of living things which are embodied in the writings of Aristotle, or the pictures of disease and its symptoms to be found in the clinical records of Hippocrates. Do we not still speak of the "facies Hippocratica" and of Hippocratic succession?

We cannot doubt that there were forerunners of Aristotle, nor that much of the knowledge embodied in his books had been collected by lesser men. Nor can we doubt that there were scientific physicians before Hippocrates, men of the schools of Cnidus and Cos, some of whose writings are included in the Hippocratic corpus. Indeed, Aristotle, whose lifetime overlapped that of Hippocrates, bears witness to this when he speaks of physicians as men who usually base their medical theories upon principles derived from physics. We must rather suppose that, like other men of genius, Hippocrates illuminated and crystallized the floating knowledge in the atmosphere of the Asklepieion. But Hippocrates was something more than a man of science, for when we read what he has written we realize that the most cherished traditions of our profession, the rules of its conduct, were inherent in the Father of Medicine, the author of the Hippocratic oath.

When, at a later period, the centre of Greek medicine shifted to Alexandria, Erasistratus and Herophilus had opportunities for the practical study of human anatomy such as none had before them; and in the second century of our era, the Greek tradition culminated in the life and writings of Claudius Galen, a great physician, a true inquirer of Nature, author of many treatises, imbued with the spirit of Hippocrates, but not so great as he. It was the strange fate of this man to be set up as an oracle, to be regarded for more than a thousand years as infallible and his statements as admitting of no appeal. Then after Galen the curtain falls, to be rung up again only in the sixteenth century of our era.

During that long inter-act the races which had overthrown and overrun the empire of Rome were being educated *de novo*, to appreciate the culture which they had destroyed. Meanwhile, the keeping of the works of the ancient physicians passed to the Arab races, and for centuries were only known in Syriac or Arabian translations, or in retranslations from those tongues into Latin. Then in the end science stirred in her sleep in the thirteenth, and finally reawakened in the sixteenth century. There was indeed much leeway to be made up. Even as late as in the year 1559 Dr. John Geynes was cited before

this College because he impugned the infallibility of Galen and was obliged to sign a solemn recantation of his error: "Ego Johannes Geynes fateor Galenum, in iis quæ proposui contra eum, non errasse." Surely, in the Elysian fields, the shade of Galen chuckled!

Great as were the achievements of the fathers of medicine, they began to construct their edifice with the attics. Their anatomy was almost wholly that of the lower animals, and the physiology of Galen seems to us grotesque. The sciences upon which anatomy and physiology rest were hardly yet born. If medicine were to be established upon a scientific basis the structure needed to be firm from the ground upwards, and from the sixteenth century onwards the foundation sciences, and those which form the lower stories, have been cultivated and advanced largely by medical men who saw them to be essential to the progress of their own science and art.

So medicine, oldest of applied sciences, older indeed than the sciences applied, has through the ages furthered the growth of natural knowledge. How profound her influence has been, and how it has been exerted, it is my present aim to show.

Research and education are closely linked, but whereas from their earliest days there have existed, in the universities of Europe, the three professional faculties of Divinity, Law, and Medicine, that of Natural Science is of quite recent development. For the student with a scientific bent two paths were open: he might either attach himself to the Faculty of Medicine, or might approach his chosen studies by way of mathematics.

Even down to the seventeenth century, or later, the university course in medicine was almost wholly theoretical. The Professor expounded to his pupils the writings of Hippocrates and Galen, together with those of some of the great Arabians, such as Avicenna and Rhazes. Such were the duties assigned by Linacre to his lecturers at Oxford and Cambridge, and those of the Regius Professors at those ancient seats of learning. Thomas Molyneux (1661-1733), a young graduate of Dublin, where he was afterwards Professor of Medicine, visited Oxford in 1683, and heard the Regius Professor, Dr. Luff, "read on the first aphorism of Hippocrates in the Physic School; where giving an account of the shortness of man's life since, and the length of it before the flood, he made up of Mr. Burnett's fancy, not at all altered but in the word." No wonder that Molyneux was not diverted from his purpose to continue his studies at Leyden, where clinical medicine was being taught in a university clinic. Elsewhere clinical knowledge was acquired by attendance upon the practice of a physician or surgeon, a system of apprenticeship which has this to its credit—that out of it has grown the English system of bedside instruction to small groups of students. The first attempt to start clinical teaching within the university was made in Padua in the late sixteenth century, but the first organized clinic was that in Leyden, started in about the year 1630.

The study of science for its own sake, apart from any professional applications, began again in the sixteenth century, and was active in the century which followed. In this country Oxford took a large part in the renaissance of pure science. There Robert Boyle, the "father of chemistry," set up his private laboratory in 1654; and around John Wilkins, Warden of Wadham—the college of Mayow and Sydenham, and one to which science and medicine owe much—there gathered a group of men eager for the advancement of natural knowledge, who, with the members of the "Invisible College" in London, formed the nucleus of the future Royal Society. In the same century chairs of astronomy, natural philosophy, anatomy and botany were founded in Oxford, and the Botanic Garden was established. In 1657 Thomas Millington (1628-1704), a President of this College, was made Sedleian Professor of Natural Philosophy; and the first Savilian Professor of Geometry and Astronomy, John Bainbridge (1582-1643), was also one of our Fellows.

How large a part members of our profession played in this reawakening of science is shown by the large proportion of medical men among the original Fellows

of the Royal Society. Of the total of 115, which included peers, clerics, and distinguished people such as John Evelyn and Samuel Pepys, only a small proportion were men of science in any strict sense, and of these no less than 25 were Doctors of Medicine, whilst 21 were Fellows of this College.

In the reawakening of medical science Italy took the lead, and especially in the study of anatomy. Of her universities, Padua, under the enlightened rule of the Venetian Republic, became the chief centre of medical teaching in Europe, and thither repaired the pick of our English students to profit by teaching such as they could not obtain at home. Later, when the star of Padua paled for a time, Leyden took its place as the cynosure of students of medicine.

Of the professions open to him in former centuries that of medicine would obviously make most appeal to the youth of scientific bent, and as L. C. Miall puts it in his book on "The Early Naturalists":

"The medical school furnished the only regular training for the naturalist, whilst he found in the medical profession the likeliest means of earning his bread."

In his Rectorial Address to the University of Aberdeen, delivered in 1874, Huxley brought out the same point, with even wider application, when he said:

"Within my recollection, the only way in which a student could obtain anything like a training in physical science was by attending the lectures of professors of physical and natural science attached to the medical schools."

Still more striking is the following passage from the same address:

"In the days when all the innumerable applications of physical science to practical purposes were non-existent even in dreams; days which men living have heard their fathers speak of, what little physical science could be seen to bear directly upon human life lay within the province of medicine. Medicine was the foster-mother of chemistry, because it had to do with the preparation of drugs and the detection of poisons; of botany because it enabled the physician to recognize medicinal herbs; of comparative anatomy and physiology, because the man who studied human anatomy and physiology for purely practical purposes was led to extend his studies to the rest of the animal world."

Now that the practical applications of science are so far greater even than when these words were spoken, and a course of scientific training is necessary or desirable as a preparation for so many walks of life, there have sprung up schools of physical science of which the Royal School of Mines and the College of Chemistry, now fused into the Imperial College of Science, were the earliest to be established in this country. Our universities also teach science in all its branches, and grant degrees therein. In a word, science has been weaned from its foster-mother.

Seeing, then, that in the past medicine has supplied opportunities of education for students of natural philosophy and natural history, and has, at the same time, supplied a stimulus to their researches, it need cause no surprise that our profession can claim, amongst its most honoured members, not a few whose work has inaugurated new epochs in widely diverse branches of natural knowledge.

At first sight it would appear that astronomy, to which the natural approach is through mathematics, is as remote from medicine as any science can be; but there was a time when the pseudo-science of astrology supplied a close tie between the study of the stars and that of disease. The mediæval physician was profoundly influenced by the horoscope of his patient, and studied the motions and conjunctions of the planets to obtain such help in diagnosis and prognosis, as is afforded nowadays by the blood count or electro-cardiogram. He was expected to have some knowledge of astrology, and even in the sixteenth century there were amongst our Fellows such men as Thomas Twyne (1543-1613), who gained more fame as an astrologer than as a physician, and some note as a poet. True medical astronomers, on the other hand, have been few in number, but Nicolas Copernicus (1473-1543), who revolutionized man's ideas of the universe, was a physician, and amongst lesser lights mention may be made of our Fellow John Bainbridge.

Another science which has little contact with medicine is geology, save in so far as the nature of soils has bearings upon public health; but medical men have played very important parts in its advancement. Thus, Nicholas Steensen, commonly called Steno (1638-1686), who discovered the parotid duct which bears his name, may be described as one of the founders of geology and mineralogy. Most of his active life was spent in Florence, where he held the post of physician to two successive Grand Dukes. Of him von Zittel wrote, in his *History of Geology*, that he was the first who sought to solve geological problems by inductive reasoning. He threw much light upon the formation and structure of crystals, and, as Leonardo da Vinci had done a century and a half earlier, he maintained that fossils are the actual remains of animals and plants of former epochs. He ended his life as a Catholic bishop, and his ascetic habits undermined his health. This brilliant Dane is entitled to rank amongst the great ones of science, as anatomist, geologist, mineralogist, and physician, but his researches, so far in advance of his time, only received their due recognition after much of his work had been done over again by later investigators.

John Woodward (1665-1728), Professor of Medicine at Gresham College, and Fellow of this College, also holds a distinguished place in the annals of geology. By his observations he acquired a most extensive knowledge of the structure of the earth's crust, and had learnt much as to the superposition of the various strata, but he propounded a fantastic hypothesis that the whole globe had been taken to pieces at Noah's flood, and that from the resulting "promiscuous mass" the various strata had been deposited in quick succession. He bequeathed his collections to the University of Cambridge, where they form the nucleus of the museum which bears his name. Woodward was less eminent as a physician than as a geologist, and was evidently a quarrelsome fellow, for he forfeited his Fellowship of the Royal Society because he insulted Sir Hans Sloane, to whom he refused to apologize; and a quarrel with Mead, over the treatment of small-pox, led to a passage of arms, in which the sword of Mead but the tongue of Woodward gained the mastery. "Take your life," said Mead. "Anything but your physic," was the reply. The celebrated James Hutton also (1726-1797), who propounded the rival and sounder theory that the moulding of the crust of the earth has been effected gradually, by processes such as are now at work, was a Doctor of Medicine of Leyden, but soon abandoned the idea of medical practice.

In more recent times the presidential chair of the Geological Society has been occupied by William Babington (1756-1833), physician to Guy's Hospital, and by John Whittaker Hulke (1830-1895), surgeon to the Middlesex Hospital, to whom that Society awarded the highest prize in its gift—the Wollaston medal, founded by our former Fellow, the distinguished chemist and mineralogist of that name.

Physics and chemistry are the fundamental sciences upon which physiology and medicine rest, and throughout their history have been closely associated with medicine. Galileo Galilei (1564-1642), equally pre-eminent as astronomer and physicist, was a student of medicine when he watched the swing of the lamp in Pisa Cathedral, and so discovered the law of the pendulum. It was by his pulse that he timed the swing, and the first use which he made of his discovery was to construct an instrument to measure the frequency of its beats. The other outstanding physicist of the sixteenth century was a Fellow, and sometime President of this College, William Gilbert (1540-1603), founder of the science of magnetism, who recognized the earth's magnetic properties. Of him Dryden wrote:

"Gilbert shall live till loadstones cease to draw,
Or British fleets the boundless ocean awe."

This College can also claim amongst its Fellows one of the most brilliant men of science whom our country has produced, Thomas Young (1773-1829), whose discoveries in optics, and especially that of the interference of light, went far to establish the undulatory theory. He was the first to detect astigmatism, and threw much light upon

the mechanism of the eye and on colour vision. He was a great linguist also, and by his work on the Rosetta stone aided materially the interpretation of the demotic text thereof. Yet he found time to hold the office of physician to St. George's Hospital, and to practise medicine.

Amongst other great medical physicists I may recall the name of Luigi Galvani (1737-1798), physician and anatomist, who was led to the discovery of current electricity by his investigations of the electric organs of certain fishes; William Charles Wells (1757-1817), who solved the problem of dew; Julius Mayer, physician of Heilbronn, to whom is due some of the credit of the determination of the mechanical equivalent of heat; and, in our own time, Hermann von Helmholtz.

There was a time, towards the end of the seventeenth century, when a dominant position in medical thought was held by a group of so-called iatro-physicists, who, influenced by the work of Galileo and his followers, and by the views on physiological problems of two great mathematicians—Descartes (1596-1650) and Borelli (1608-1679)—endeavoured, but with far less competence, to extend them to all physiological processes by the supposed action of forces upon particles of various shapes and sizes. Like the iatro-chemists, whom they superseded, they went too far, had their day, and passed. In the true line of succession from Borelli, on the other hand, was James Jurin (1684-1750), a Fellow of this College and physician to Guy's Hospital. He was an eminent mathematician and physicist, whose aim it was to make physiology an exact science.

With chemistry the links are even closer. The alchemist, who sought to prepare the elixir of life, had kindred aims to those of the physician. Later, in the period of the iatro-chemists—followers of Paracelsus, van Helmont, and Sylvius—medicine was regarded as a mere branch of chemistry, and physiology as a study of fermentations—curiously like, and yet quite unlike, the physiology of to-day. A more practical tie between chemistry and medicine was provided by the chemical side of pharmacy and the study of poisons.

It was not until the seventeenth century that chemistry began to be studied as a pure science—in the days of Robert Boyle, upon whom, as an appropriate recognition, Oxford bestowed the degree of Doctor of Medicine, and others who, like him, were actuated by a desire to know the nature and composition of things. At Oxford, the second holder of the short-lived Ashmolean Professorship of Chemistry, Edward Hanes (died 1710), was a physician; in the early years of the eighteenth century lectures on chemistry were given by John Freind (1675-1728), a Fellow of our College and Harveian Orator, and by several other medical graduates; and the first holder of the Aldrichian chair, founded in 1803, was John Kidd, afterwards Regius Professor of Medicine.

In the earlier days a knowledge of practical chemistry was only to be acquired by students in the shops of apothecaries, and as a scientific training this left much to be desired. It was Vauquelin (1763-1829) who first organized courses of instruction in his own laboratory in Paris, and this method was followed by Thenard (1777-1857) and Gay Lussac (1763-1829) and greatly extended by Liebig (1803-1873). Ernst von Meyer states that the laboratory of Thomas Thomson (1773-1852), a doctor of medicine of Edinburgh and professor of chemistry in Glasgow, was the first to provide practical teaching in Great Britain, and it was not until 1845 that the College of Chemistry was established in London, with A. W. Hofmann as its director.

The list of physician chemists is a long one, and only a few of the most eminent can be mentioned. First may be recalled John Mayow (1643-1675), one of the greatest of them all. Mayow stands high on the roll of physiologists, as well as of chemists. From the point which he reached only one step remained to the complete explanation of respiration and combustion, and but for his too early death the discovery of oxygen would almost certainly have been antedated by a century, and phlogiston would never have been heard of. Although a doctor of civil law, Mayow practised medicine at Bath. A contemporary of Mayow was our Fellow Thomas Willis (1621-1675), whose work upon the anatomy of the brain is commemorated by the circle

of arteries which bears his name. But Willis was also no mean chemist, and to him we owe the discovery of glycosuria. Mention must be made of Friedrich Hofmann of Halle (1660-1742), a contemporary of Boerhaave, and of the illustrious Herman Boerhaave (1668-1738) himself, whose treatise on chemistry was long the best textbook of the subject. Yet eminent as Boerhaave was as a chemist, it was as a physician and professor of medicine that he was pre-eminent, and it was during his tenure of its chair of physic that Leyden, as a school of medicine, reached its zenith. Cullen (1710-1790), Joseph Black (1728-1799) the discoverer of latent heat, and Wöhler (1800-1882), who, by his synthesis of urea, bridged the imaginary gap between inorganic and organic compounds, were all members of our profession who made notable contributions to chemical knowledge. It was a Professor of Medicine of Halle, Georg Ernst Stahl (1660-1734), who propounded the strange theory of phlogiston, which, like the old man of the sea, clung around the neck of chemistry and obsessed chemists for more than a century. This hypothesis, which presented an inverted picture of the truth, like a glove turned inside out, was upheld by men of the highest ability, and by none more tenaciously than by such men as Priestley and Scheele, whose own researches were knocking away the props upon which it rested. The great Swedish man of science, Berzelius (1779-1848), the foremost chemist of his time, and the inventor of our system of chemical symbols and formulae, was a doctor, and for a time a professor, of medicine; and it was by his friend Alexander Marcet, a Fellow of this College, and one whose services to biochemistry are not sufficiently remembered, that Berzelius was led to illustrate his lectures by experiments.

Two more physician chemists may complete our series—William Hyde Wollaston (1766-1828), a Fellow of this College, a most eminent man of science, whose contributions extend over physiology and pathology, mineralogy, optics, botany, and, above all, chemistry; and William Prout (1785-1850). Wollaston discovered the malleability of platinum, a property of great value to chemists and physicists alike, detected cystin in urinary calculi, and invented the camera lucida. Prout was one of the founders of biochemistry, and discoverer of the hydrochloric acid in the gastric juice. His much discussed hypothesis, usually spoken of as "Prout's law," that the atomic weights of other elements are multiples of that of hydrogen, and that hydrogen is the basal substance from which all the other elements are formed, has long served as a potent stimulus to observation and research, and now, in a sense, is coming to its own.

In these later days the ties between medicine and chemistry are being knit more closely than ever before. Most drugs of recent introduction are, like aspirin, by-products of the gas-works or dye factory, or, like salvarsan and its allies, synthetic products of the laboratory. But far more important to the progress of medical knowledge is the light which is being thrown, by the rapid advance of biochemistry, upon the problems of metabolism and chemical structure of the body.

The history of other sciences tells a like story. Almost all the early botanists were medical men, and the chief stimulus to the study of botany was the search for useful drugs. This is true even of classical times, the days of Theophrastus and of Dioscorides. The early scientists were with few exceptions, such as Archimedes, observers rather than experimenters, and the mere differentiation and naming of genera and species—a branch of science which dates back to the Garden of Eden, and of which that great naturalist, Linnaeus, was a brilliant exponent—afforded an immense field of work. Of the *Materia Medica* of Dioscorides Charles Singer writes: "Its history has shown it to be one of the most influential botanical treatises ever penned. It provided most of the little botanical knowledge that reached the Middle Ages. It furnished the chief stimulus to botanical research at the time of the Renaissance." In the fifteenth and following centuries a long line of medical botanists carried on the tradition, including Brunfels (1484-1534), Fuchs (1501-1566), Bock (1498-1554), and Gesner (1516-1565), the most learned naturalist of his century, botanist, zoologist, artist,

and professor of Greek, who died of plague whilst faithfully carrying out his duty, as town physician at Zürich, during an epidemic of that malady.

But to quote Miall once more: "It was generally believed that for every ill that flesh is heir to, Nature had designated some plant as the appropriate cure"; and again, "Some believed that Providence had caused particular plants to grow in those districts where the diseases which they cure are prevalent." Can it be denied that such tenets are held by millions at the present day?

The high distinction of having initiated the study of vegetable anatomy and physiology, those higher branches of botany, is shared by two men of the seventeenth century, both of whom were physicians. One of them, Nehemiah Grew (1641-1712), we may proudly claim as a Fellow of our College. He it was who first recognized the sexes of plants and the functions of the stamens, but he himself gives some of the credit for this to our former President, Thomas Millington. Of Grew, Hallam wrote that "no man, perhaps, who created a science has carried it farther," but he must share the renown with no less a colleague than Marcello Malpighi (1628-1694), in whose splendid record the study of plant anatomy takes but a minor place. A professor of medicine, zoologist, and botanist, founder of the science of embryology, elucidator of the structure of the lung, spleen, and kidney, to Malpighi must be assigned very high rank amongst those who have contributed to the advancement of natural knowledge.

On the other side, the greatest of systematic botanists, and founder of our system of nomenclature of plants and animals, Carl Linné, commonly called Linnaeus (1707-1778), who has been said to have "found botany a chaos and left it a cosmos," was not only a doctor of medicine, but held the office of physician to the Swedish navy, and practised in Stockholm for a time.

The ties between medicine and zoology are less obvious, for the search for animal drugs can hardly have led anyone to the study of natural history. But the transition from human to comparative anatomy is easy, and there have been medical zoologists from early times. In the sixteenth century we find the names of Rondelet (1507-1566), Belon (1517-1564), Conrad Gesner once more, and of our own former President Edward Wotton (1492-1555), whose work, *De Differentiis Animalium*, gained for him a European reputation, but is marked rather by erudition than by originality of outlook and observation. In the seventeenth century there lived and worked Malpighi, whose chief contribution to zoology was a very complete study of the anatomy of the silkworm; Swammerdam (1637-1680), the Dutch microscopist who first observed the red corpuscles of the blood; and two Fellows of this College—Martin Lister (1638-1712), a man with wide interests and a special bent for the study of marine and freshwater molluscs; and Edward Tyson (1650-1708), the author of monographs upon the chimpanzee, porpoise, opossum, and rattlesnake, and who first described the patterns upon the finger-tips.

In recent times we may claim Richard Owen (1804-1892), who was credited with the power of reconstructing an extinct monster from a single bone; and also one whose eloquent words still ring in the ears of some of us, the greatest of medical zoologists, Thomas Henry Huxley (1825-1895).

In reality, botany and zoology are far more closely allied to medicine than our fathers knew. Since most maladies are due to invasion of the body by lowly organisms, some animal and some vegetable, we need to approach the study of disease from the standpoint of the invaders which are ever trying to gain a foothold, as well as from that of the tissues which resent the role of a culture medium and offer all the resistance in their power. In that struggle, which is waged with varying fortunes, we physicians are the allies of our patients, whose own tissues play the chief part in the defence. In order that our aid should be as efficient as possible we need to know all that can be learned about the nature and habits of the invaders, and of the insects which are the other hosts of some of them; and the study of bacteria is a branch of botany, and that of protozoa of zoology.

At the renaissance of the medical sciences it was in human anatomy that the first advances were made, and the new anatomy was based upon dissection of the human body. The pioneer of this advance was Andreas Vesalius (1514-1564). His work was carried on in Padua. Others had dissected the human body before him, in Alexandria and at a later time in Bologna, but the prevalent teaching of anatomy followed the text of Galen, and was based, almost wholly, upon dissections of monkeys and lower animals. From Vesalius dates the great period of the medical school of Padua, during which there taught there, after Vesalius, Fallopius (1523-1562), Fabricius of Aquapendente (1537-1619), Casserius (1561-1616), and Spigelius (1578-1625)—men whose names are written large upon the organs and tissues of the body. To Padua also, despite the difficulties, discomforts, and even dangers of travel in those times, came students from afar, and amongst them our own Thomas Linacre, John Caius, and William Harvey. As Sir Clifford Allbutt justly said, in his notable Harveian Oration, delivered a quarter of a century ago: "It was in Padua that medicine, long degraded and disguised, was now 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."

It is not necessary that I should dwell upon the share of medical men in the building up of modern physiology, for from Harvey onwards it has been almost entirely their work; but the day has passed in which physiology was regarded as the handmaid of medicine, and it has taken its proper place as a great independent science.

Morbid anatomy, as an adjunct to clinical medicine, dates back to the illustrious Morgagni (1682-1772), and so to Padua once more, and is intimately associated with the other great names of Albert von Haller (1708-1777) and Rudolph Virchow. Knowledge of the changes, both great and minute, wrought by disease in the organs and tissues is still as essential as ever in the training of the physician and surgeon, but morbid anatomy is no longer coextensive with pathology, and the pathology of to-day has entered upon entirely new fields. So, as we well know, modern pathology has rendered possible the destruction of the agents of disease, or of their insect hosts before they reach the body—the triumphant achievements of preventive medicine. Moreover, as the result of the study of immunity, the bacteriologist is teaching us how to apply Nature's own selective remedies in place of the cruder drugs of earlier days. At the same time, the pharmacologists are bringing to the test of scientific method the actions and uses of drugs which have long been used in an empirical way, and are able to explain the proved utility of some which owe their introduction into the pharmacopoeia to superstition, or to some grotesque hypothesis.

So, from the foundations of chemistry, physics, and biology, through the lower stories of human anatomy and physiology, of pathology and pharmacology, we reach the attic once more, and come back to Hippocrates, to the bedside examination of the sick and injured. But, now that the foundations have been well and truly laid, the clinical medicine of to-day is able to advance on scientific lines, and the study of the abnormal can be based upon a knowledge of the normal.

All who have taken part in this work, all those heroes of science and medicine whose names have been mentioned, may rank as benefactors of this College, both those who were its Fellows and those who were not, and in commemorating them I may claim to have followed Harvey's first injunction.

It is natural, nay inevitable, that as medical science grows and advances, some of the workers in the field should elect to follow the path which leads through the laboratory, whereas to others the wards make a stronger appeal; and thus is taking place a differentiation of medical workers into distinct groups, and there is danger that the fission may go too far. The worker in the laboratory, wedded to his more exact methods, and distrustful of those with which the clinician is often compelled to be content, is apt to place his bedside colleague in a lower grade or

caste than his own. He is apt to look too much at the disease and too little at the patient, and to forget how greatly the former is shaped by the reactions and idiosyncrasies of the latter.

We all know that a line of treatment resting upon a strictly rational basis may be useless or even harmful in an individual case. It would be nothing short of a calamity were all the best scientific workers who enter our profession to be diverted from its clinical side to laboratory investigation, for of no walk of life is it more true than of the practice of our art that "the multitude of the wise is the welfare of the world." From the ranks of the clinical workers have been drawn those who, in the past, have built up medical science. It was in the intervals of their clinical practice that such men as Harvey himself, William Gilbert, Nehemiah Grew, and Thomas Young carried out the researches which have made them for ever famous; and, indeed, clinical medicine is itself essentially scientific.

But clinical medicine is an art as well as a science, and in the sick-room many qualities are called for which are not essential in the laboratory. A man who is deeply imbued with the spirit of science may prove a very poor practitioner, whereas another, rich in common sense, sound knowledge, experience, and human sympathy, but to whom abstract science makes little appeal, may make a very good one. Tact and equanimity, courage and restraint, patience with fads and sympathy with grief, diagnostic skill and manual dexterity are qualities called for in the daily work of the practitioner of medicine or surgery. The marvel is that, on the scientific side, he has accomplished so much, not that he has failed to accomplish more. It ill becomes his colleagues in the laboratory to think slightly of him.

Medicine, indeed, embraces a number of constituent sciences, and for the attainment of her beneficent aims all her branches need to work together in mutual respect, amity, and concord; to bear in mind Harvey's third injunction to that effect, and his reminder that: "Concordiâ res parvæ crescunt, discordiâ magnæ dilabuntur."

Not only are the diagnostic methods which we employ in accord with the demands of science, but also, by the bedside study of signs and symptoms, and the recognition of the morbid anatomical changes with which they are associated, as also by the observation of the effects of surgical removal or gunshot injury of parts, very notable contributions to physiology have been made.

Consider for a moment how our knowledge of the functions of the endocrine glands has been obtained. The acumen and care in observation of that splendid clinician Addison threw the first ray of light upon the subject, and removed the adrenal glands from the realm of mystery into that of observed fact. The gradual accumulation of facts concerning exophthalmic goitre, Gull's discovery of myxœdema, Kocher's observations upon cachexia strumipriva, and the effects of thyroid treatment, provide a connected story of clinical work in medicine and surgery, which led up to a solution of the functions of the thyroid gland, and which had its practical outcome in the restoration to health of many sufferers from myxœdema, the rescue of many cretins from imbecility and arrest of growth, and the amelioration of the lot of many sufferers from Graves's disease. Again, it was the recognition of acromegaly by Pierre Marie, the study of its symptoms and morbid anatomy, the recognition by Fröhlich of the syndrome which bears his name, and that of the other results of pituitary defect, together with the surgical results of Cushing and others, which led us to our knowledge of the functions of the hypophysis, knowledge which has been greatly extended by the experimental work of Schafer. Moreover, the inklings we have of the functions of the pineal gland, and of the adrenal cortex, are mainly derived from clinical observations of patients with tumours of those structures.

The chance that an accidental gunshot wound left the French Canadian Alexis St. Martin with a gastric fistula, and that the American army surgeon Beaumont, under whose care he came, was able to take full advantage of the opportunity so afforded of studying the secretion and action

of the gastric juice, proved of the utmost value in the elucidation of the problems of digestion. And in these times many clinical devices, such as test meals, duodenal soundings, and bismuth meals, are throwing yet further light upon physiological as well as pathological processes.

The knowledge acquired in recent years of the mechanism of the heart's action is a triumph of scientific clinical medicine. This work, which is so closely associated with the names of James Mackenzie, Thomas Lewis, Wenckebach, and Einthoven, has been gained mainly by the study of derangements of the heart's beat in man, by means of the polygraph and electro-cardiograph.

But perhaps the most striking examples of all are afforded by the work which has been done upon the nervous system. Bouillaud described clinical and pathological physiology as the sister of experimental physiology, and since the middle of the nineteenth century an immense amount of knowledge of the functions of the brain and spinal cord has been acquired by the labours of a band of brilliant investigators, many of whom are our own countrymen, and most were, or are, physicians or surgeons. Of these I may mention Hughlings Jackson and David Ferrier, Charles Beever, Victor Horsley, and Henry Head in this country, and on the Continent, Hitzig, Erb, Westphal, and Pierre Marie. By their researches they have furthered the work of the pure physiologists, Sherrington, Gaskell, Langley, Gotch, and others.

As regards localization, the first definite steps indicating that the brain does not function as a whole, but as a congeries of organs, was the localization by Broca of the motor speech centre, in 1861, which was based upon the position of the local lesions in fatal cases of aphasia, and Hughlings Jackson's study of convulsions due to cortical lesions. These observations served as stimuli and pointed a way which was followed by many other observers, but by a not unfamiliar irony of things the assignment of a speech centre to the convolution of Broca no longer meets with acceptance.

Lastly may be cited the work of Head upon the seats of pain due to visceral lesions, and upon epicritic and protopathic sensations. It is clear that clinical observation is the royal road to the study of many kinds of sensory disturbance, in which an intelligent subject who can describe his sensations is needed, and in some instances the investigators have controlled their clinical observations by experiments upon themselves.

The examples quoted show that, apart from the study of disease in bulk, and by statistical methods, there is also much to be learnt from the detailed study of individual cases.

In a letter which Harvey wrote only six weeks before his death, to a Dutch physician who had sent him an unusual specimen, occurs the following passage: "It is even so—Nature is nowhere accustomed more openly to display her secret mysteries than in cases where she shows traces of her workings apart from the beaten path; nor is there any better way to advance the proper practice of medicine than to give our minds to the discovery of the usual law of Nature, by careful investigation of cases of rarer forms of disease. For it has been found, in almost all things, that what they contain of useful or applicable is hardly perceived unless we are deprived of them, or they become deranged in some way."

These words, as true to-day as when they were written, are full of encouragement for those of us for whom the study of Nature's experiments and mistakes has a special attraction. The structural malformation, or the hereditary and inborn departure from the normal of metabolism, although unimportant from the practical standpoint, may throw a ray of light into some dark place of embryology or biochemistry; and not a few of the rare maladies, such as chloroma, polycythaemia vera, sulphæmoglobinæmia, and the disease of which Bence-Jones albuminuria is a sign, offer fascinating and still unsolved problems of physiology and pathology.

Obviously clinical medicine presents immense fields of scientific research, and those who cultivate them have the added satisfaction of knowing that every advance of medical science will, sooner or later, bring in its train some forward movement of the healing art.

So, as we trace the history of natural science down through the centuries, we are confronted at every stage by the influence of medicine upon its progress. The desire to alleviate human suffering, to repair the ravages of disease, and to mend the broken part, has served as a powerful stimulus to observation and experimental work. It soon became obvious to the would-be healers that to understand disease they must needs understand the healthy workings of the organism, and that pure science must precede applied. So, as Huxley said, medicine became the foster-mother of the sciences. But she became their school-mistress also, and attracted to herself men whose scientific abilities would hardly have found an outlet in the other walks of life open to them in the earlier days, and whom she not only taught but supplied with means of livelihood whilst they pursued their chosen studies. Her part was rather that of a mother than of a foster-mother. They, in their turn, repaid her care by laying firm foundations upon which a rational healing art could be built up, and, as we have seen, not a few of them achieved epoch-making results in sciences outside the range of medicine.

Thus it has come about that immense, and indeed incalculable, as is the debt of medicine to the pure sciences, the debt of science to medicine is hardly if at all less great. But these mutual obligations are but internal debts, and the fact that medicine, in its widest sense, is merely a branch of natural science was recognized even by Aristotle, who, at the end of his work on respiration, wrote as follows:

"Our discussion of life and death and kindred topics is now practically complete. But health and disease also claim the attention of the scientist and not merely the physician, in so far as an account of their causes is concerned. The extent to which these two differ, and investigate diverse provinces must not escape us, since facts show that their inquiries are, to a certain extent at least, continuous. For physicians of culture and refinement make some mention of natural science, and claim to derive their principles from it, while the most accomplished investigators into nature generally push their studies so far as to conclude with an account of medical principles."

Yet, as Huxley pointed out, "It is a peculiarity of the physical sciences that they are independent in proportion as they are imperfect; and it is only as they advance that the bonds which unite them become apparent." That this is so is far more obvious to-day than when these words were spoken more than forty years ago. For as we gain more knowledge innumerable fresh links are brought to light; and the unity of natural science is daily being revealed more clearly as the boundaries of its several branches fade and become indistinct.

Few will any longer question the view that physiology is merely the chemistry and physics of living things. Physics has captured the structure of the atom, is absorbing chemistry into itself, and is becoming revealed as the great fundamental science, of which all the others are but branches. In this great complex of interlocked studies those which we class together under the comprehensive name of medicine have their allotted places, and advance in any one branch forwards the progress of the whole. To take our part in this progress is alike our privilege and our obligation as members of the great band of seekers after natural knowledge.

Upon the ceiling of the cloister of the University of Padua there are painted "stemmata" which record the sojourn there of many students who were councillors of their several "Nations," and amongst them are two which bear the name of Gulielmus Harvey, Anglus. Some of the designs are heraldic, but Harvey's is symbolic, nay prophetic. A right arm and hand holds up a caduceus, in which, in place of a lifeless staff, the twin serpents are entwined around a lighted candle which throws out beams in all directions. What more fitting emblem could have been devised? And yet these stemmata were painted when Harvey's work was scarce begun, and when he was still a member of the student body. To "search and study out the secrets of Nature by way of experiment" was his own way of life, and it is my duty to obey his injunction, and to exhort our younger brethren in the College to tread the path in which he led the way, and to see to it that in their hands the flame which Harvey lit shall burn as brightly as in Harvey's day.