day after day, and year after year, in company with Sydenham, he made his observations, botanical, climatic, political, social, and statistical, as well as medical. And as a doctor, in this situation, he conceived of the great *Essay* concerning human understanding. When *Principia* was published, Locke was baffled by the mathematics. He had nothing to do with the Newtonian/mathematical development of the Royal Society. But as an early Fellow, Locke the doctor began the whole empirical movement of modern philosophy.

THE DEBT OF SCIENCE TO MEDICINE

BY

CHARLES E. RAVEN, D.D., D.Sc., F.B.A.

The foundation of the Royal Society 300 years ago represents not only a critical event in British history by the provision of an instrument whose influence brought this country in one generation from a position of insignificance to the forefront of the whole scientific movement, but a signal demonstration of the coming of age of modern man. Most historians will agree that our present epoch was inaugurated not at the Renaissance or by the Reformation, but in the seventeenth century, when the New Philosophy, expounded by Francis Bacon and evangelized by Comenius, integrated and explored the whole field of natural knowledge. Mr. Laslett's article in this issue expounds the particular value of its medical members to the origination and maintenance of the Royal Society. Here we will consider in more general terms the contribution of Medicine to the movement of thought and life of which the Society became the symbol and instrument in 1662.

The debt of our Western world to Greek medicine and in particular to the Hippocratic Colleges and the doctors' oath of service, and to the two pillars of medical learning—the anatomy and physiology of Galen and the botany and pharmacy of Dioscorides—has hardly yet been adequately acknowledged: the whole framework of our University education owes its origin principally to them. The Arabian doctors, trained on the works of Aristotle and bringing back to Spain and Europe the glory of Greek science, stimulated the scholastic movement of the thirteenth century. The invention of printing gave the world a flood of Greek and Latin classics, and provided scholars with the knowledge from which the whole field of nature could be surveyed. It took a century and a half to digest this knowledge, to compare it with the traditional lore of geographers and astronomers, of the herbals and bestiaries, of alchemists and magicians; but during that period it was in the medical profession even more than by the clergy and reformers that the new biology, cosmology, and philosophy were developed. We have only to remember the influence of Salerno upon Padua and the other great universities of Northern Italy, upon Montpellier and Basel, upon Louvain and Oxford, Leyden and Cambridge; the scholars like Ermolao Barbaro, Jean Ruel, and our own Edward Wotton, in 1541 President of the College of Physicians; and their successor Conrad Gesner of Zürich and his vast correspondence with doctors all over Europe from Lisbon to Dantzic, and from Naples to London, and with the two English physicians and scientists William

Turner and John Caius, to see how direct and continuous was the service of the world of medicine to the expansion and the unifying of the studies of the organic world, of biology and physiology, and perhaps most effectively of botany. It is true to say that the study of plants, their taxonomy, their "uses and values," their employment as drugs, and their care and cultivation, had reached a true scientific status a generation before the influence of Copernicus had been felt even in the centres of learning. And practically all the contributors to this epoch-making achievement were medical men.

Gesner and the British Naturalists

Of them all Conrad Gesner is beyond question the outstanding leader. The orphaned son of a follower of Zwingli, he was bred up in the tradition of Erasmus and by the most enlightened leaders of the Reformation in Switzerland. Beginning with the classics, but early developing a passionate interest in nature, he studied the whole literature of science, composed the huge volumes on animals, reptiles, birds, and fishes, prepared for a similar treatise on insects, and had collected some thousand pictures and masses of notes of plants. Over eighty books were published by him before his early death, and his voluminous letters to dozens of doctors and naturalists gave unity and leadership to the scientific study of the flora and fauna, the cosmology and physiology of our world. Both our British naturalists were his personal friends: from Turner he received the first list of British fishes, and from Caius not only the book on dogs, but a long series of pictures drawn by Caius himself from the animals that he saw in the London docks and markets and in the Lion Gate of the Tower, which was at that time our only zoological gardens. Among these pictures was an excellent drawing of a female elk which Caius described by the name of horse-deer, because, as he explained, though the Norwegian sailors who had imported the animal called it an elk, Julius Caesar had stated that the true elk had no joints in its legs, "therefore this cannot be an elk." Gesner's reply, while grateful and gracious, states plainly "though Caesar says this about the elk just as Herodotus says it of the elephant, both statements are false: there is no animal without jointed legs."

This is a good illustration of the principal problem of these early investigations: how were they to deal with the vast mass of lore and fable which for a thousand years had done duty as natural history? Not only unicorns and gryphons, the yale and the phoenix, but lions and cranes, the fox and the crow, were the heroes of a library of legends and anecdotes, and familiar through centuries of sermons and moralizings. We can see from a comparison (say) of Shakespeare with Milton how the old world of Caliban and Ariel, of fairies and witches, gave place to the realm of law and observation, of Areopagitica and the classics: but for the men of the sixteenth and early seventeenth centuries the change demanded a discipline not only of literary criticism, but of observation and experiment quite strange to the tradition of culture and religion. When we add that even the classical authorities—even Aristotle and Theophrastus—were describing only the beasts and plants of the Eastern Mediterranean, we can realize something of the difficulties which Turner, when he wrote the first list of birds or tried to identify the flora of the Northumberland coast or the East Anglian fens, had to overcome. Only an intense scrutiny of the classical

descriptions and a close co-operation with colleagues in other countries made the task practicable. If it had not been for the excellence of the artists who illustrated the herbals of Brunfels and Fuchs, and the diligence and zeal of the great publishing houses like those of Isingrin, at Basel, or Christophe Plantin, at Antwerp, the naming and classifying of plants could never have been accomplished so quickly. When we realize the scientific merits of the Bauhins and the skill and speed with which gardeners produced the pinks and tulips of the Dutch gardens, or of our own John Parkinson's *Paradisus*, we shall realize that the new age had stimulated a vitality equal to its challenge.

Medicine's Special Contribution

The special contribution of medicine in the early days of science was due to two chief causes.

In the first place the doctor's profession is concerned not with things but with people. He checks his results by their effects upon his patients, and is thus aware of human nature in its wholeness and can avoid the error both of the scientists, who are liable to treat persons as machines, and of the theologians, who regard them as fallen angels. Medicine must in its very nature adopt a psychosomatic philosophy; and in fact if we study its history we shall find that it has constantly maintained an estimate of mankind that mediates between the two extremes: from Hippocrates to Sir Russell Brain it is dealing with a creature in whom body and mind are united.

In the second place medicine has always been international in outlook and contacts; 300 years ago the doctors had for a century been men familiar with most of Western Europe. A brief survey of the outstanding medical scientists will show their breadth of experience. William Turner and John Caius had both taken medical degrees in Italy. Turner as a friend of Latimer and Ridley had left England when Henry VIII persecuted the Reformers, and went to Ferrara and Bologna, working with Brasavola and with Luca Ghini in botanic garden and herbarium, and afterwards meeting Gesner and spending some years in Germany and Friesland. He published his bird-book at Cologne, and before his return to England had visited Antwerp. Caius stayed some time at Padua and actually shared lodgings with Vesalius. He also met Gesner and kept up a close contact with him. When Turner was physician to the Duke of Somerset he introduced the growing of lucerne into England. Caius, though conservative in temper and religion, contributed the first clinical study of sweating sickness to his colleagues at home and overseas. Their follower Thomas Penny, a close friend of Peter Turner, William's doctor son, also travelled extensively, was visiting Gesner at the time of his death, and brought back to England his material for the study of insects. Practising in London, Penny was in touch not only with a large number of English doctors and naturalists but with the great botanists of the Continent, De l'Ecluse and the brothers Bauhin. His friend and colleague Thomas Mouffet took over his work on insects and prepared it for publication in 1589, being himself interested both in entomology and in dietetics. The book, *Theatrum Insectorum*, was in fact the first full account of its subject to be written, though it was probably not published until long after Mouffet's death, and then by Sir Theodore de Mayerne in 1634. Mouffet, who had himself studied under Felix Platter at Basel and travelled in Italy and Spain, was a

man socially attractive and mentally versatile, but though a champion of Paracelsus and a writer on medical subjects, he was hardly a scientist, and certainly made a poor job of his editing of Penny's work. Nevertheless, the *Theatrum* shows how numerous and widespread were the doctors interested in biology; for in addition to the many botanists reference is freely made to notes on insects supplied by John James, physician to Queen Elizabeth, Timothy Bright, of St. Bartholomew's, Edward Elmer, a surgeon working in Russia, to the painter and explorer, John White, and to the very learned Norfolk squires, Thomas and Edmund Knivet. Clearly, if the first years of the seventeenth century did not produce any medicals of the scientific eminence of Turner, Caius, and Penny, their numbers and influence made up for this: they were, it appears, more absorbed in their own profession.

Harvey, Merret, and the Invisible College

In the next generation came the greatest of all medical scientists, William Harvey, whose discovery of the circulation of the blood, recently vindicated by Louis Chauvois, must not obscure the fact of his very wide and interesting work in the whole field of natural science. It is indeed one of the tragedies of the Civil War that his collections and notes were destroyed in London while he was attending King Charles at Oxford. But his *De Generatione* contains a mass of information not only about his observations on the formation of the chick in the egg and the growth of the foetus in the deer, which he obtained from the royal herd, but about animal and bird courtship and behaviour. Harvey, who had taken his medical degree at Padua in 1602 and had lectured for many years at the College of Physicians, published his *De Motu Cordis* at Frankfurt in 1628, travelled with the Earl of Arundel in Germany and Austria, visited the Bass Rock, and in spite of his loss left much varied material to his pupil and friend Christopher Merret, a doctor practising in London, who took charge of the College of Physicians' house and museum, and who was elected an original member of the Royal Society in 1662. Having attended for some years the so-called Invisible College with Jonathan Goddard, Professor of Physic at Gresham's College, George Ent, Francis Glisson, John Wallis, William Petty, and John Wilkins, Merret was commissioned to produce a full list of the fauna, flora, and fossils of Britain, a task eminently appropriate to the first efforts of the Royal Society. He set to work with energy, enlisting the help of friends, employing an old soldier, Thomas Willis, who proved to be an excellent collector of plants and other specimens, and condensing all the literature relevant to his task. Unfortunately he was not a real naturalist or scholar, had done no first-hand work, and was often very unintelligent in his use of authorities. Nothing could be worse, for example, than his treatment of the butterflies which he copied from Mouffet, but so crudely that in his version no single species can be correctly identified. John Ray could only refer to the result as "Merret's bungling *Pinax*." It is, however, to his credit that he insisted that the fossil plants and animals were genuine creatures which "had communicated their shape to the soft earth," and quoted the fishes from Eisleben to which Gesner had drawn attention a century before.

Apart from these older men, we know from the correspondence of John Ray, as well as from its *Proceedings*, that the Royal Society elected a number of younger doctors into its Fellowship soon after its

foundation. Walter Needham, the embryologist, of Queens' College, and Thomas Allen, of Trinity and Caius, were both friends of Ray at Cambridge; both practised in London and were elected to the Royal Society in the same year as Ray, 1667. Martin Lister, the conchologist, of St. John's, whom he met at Montpellier, who became an F.R.S. in 1671 and moved to London in 1684; Tancred Robinson, Ray's closest friend, whom he met through Lister, and who travelled extensively but also settled in London, and was elected in 1684; and Hans Sloane, also a close and most devoted friend and for long the mainstay and President of the Royal Society, were the three most valued and influential of his medical colleagues and helpers. It was largely by their influence that the Society published Willoughby's book on fishes, of which Ray was the actual author, and the huge volumes of his *History of Plants*, and indeed in the very difficult period in the last two decades of the century it was their enthusiastic service which saved it from possible extinction.

Along with those thus mentioned there were a number of others, surgeons and apothecaries as well as physicians, who supported and served the Society either as Fellows, or, like Thomas Sydenham, by advice and encouragement from outside. Thanks to them, anatomy and physiology, not less than biology, advanced rapidly and to a point at which further progress had to wait until physics and chemistry had reached a scientific status—until, that is, the doctrine of the four elements had been at last abandoned and chemistry had been emancipated from magic and astrology and the myths of the alchemists. If during the next two centuries

Homo faber almost replaced *Homo sapiens*, and the machine became the symbol and instrument of human excellence, that is merely the price that has had to be paid for the accomplishment of the revolution that is now reaching its climax. As a complete and coherent interpretation of the nature of the universe becomes more attainable—and the travail of its birth is now upon us—we shall be able to appreciate more truly the stages of our history and the significance of the various contributions that have developed its progress. *Eppur si muove*: Galileo may never have uttered those words, but the more we know of evolution the more widely are they verifiable. In the later phases of the process our debt to the medical profession will become more evident.

And if many will protest and be tempted to echo the confession of Claude Bernard, greatest of physiologists. "The science of medicine of which I am supposed to lecture does not yet exist"—this is proof rather of the magnitude of the changes to be made than of the incompetence of the workers. Before we condemn the doctors for their failure to abandon the traditional beliefs and practices of their profession—for their use of intolerable medicines, their observance of folklore and superstition, their slowness in rejecting witchcraft, and crude teleology—we may perhaps admit that all other callings including the more abstract sciences have displayed similar weaknesses and that wisdom after the event, while it flatters our vanity, too often encourages us to ignore the extent to which we ourselves are obsessed by ideas and guilty of conduct which are in our moments of enlightenment seen to be absurd.

THE ROYAL SOCIETY AND ITS MEDICAL PRESIDENTS

BY

Sir ARTHUR MacNALT, K.C.B., M.A., D.M., F.R.C.P., F.R.C.S.

Fellow of University College, London

Medicine is a science as well as an art, and when the seventeenth century came—the "Insurgent Century," as Professor Singer termed it—its leading exponents were quick to seize the new learning, born of the Renaissance, and to apply its lessons to the study and treatment of disease. The august authority of the schoolmen based on their teaching of Galen and Aristotle was questioned, and Copernicus had enunciated a new theory of the universe.

"The Invisible College"

Earlier scientists had already paved the way for these inquiring minds. Vesalius gave a new anatomy; William Turner, M.D., had founded English botany; William Gilbert, M.D., had discovered magnetism and described electricity; while William Harvey discovered the circulation of the blood and was a pioneer in embryology. Amid the clash of civil war thoughtful and intelligent Englishmen perceived that in the natural world around them there were laws and phenomena, wonders and marvels that cried out for investigation. Gilbert, Francis Bacon, Abraham Cowley, and Sir William Petty had all proposed schemes for the co-ordinated study of natural philosophy; while the virtuosi, the amateurs of science, the collectors of curiosities, coins, and rarities, sought knowledge from

the scientists. Out of this alliance came the "Invisible College," said to be Robert Boyle's term for the beginnings of the Royal Society, which met weekly in London from 1645, sometimes at Dr. Goddard's lodgings, sometimes at a tavern, and thereafter at Gresham College. Of its ten members, all comparatively young, five were physicians—namely, Goddard, Ent, Glisson, Scarburgh, and Merrett. By the close of the Civil War the group were dispersed. Boyle and Dr. John Wilkins, afterwards Bishop of Chester, came to Oxford, where meetings combined with the Oxford Philosophical Society, founded in 1651, were held in Wilkins's rooms at Wadham College. Other members of the "Invisible College" remained in or near London. By 1657 the meetings had been resumed at Gresham College.

Founding of the Royal Society

On November 28, 1660, after listening to a lecture by Wren at Gresham College, the members of the "Invisible College," of whom John Evelyn and Sir Robert Moray were active leaders, planned to found "a Colledge for the Promoting of Physico-Mathematicall Experimentall Learning." King Charles II, who studied anatomy and chemistry as a hobby,* approved the

*Pepys records in 1663 that Mr. Pierce, the surgeon, and Dr. Clarke "did dissect two bodies, a man and a woman, before the King, with which the King was highly pleased."