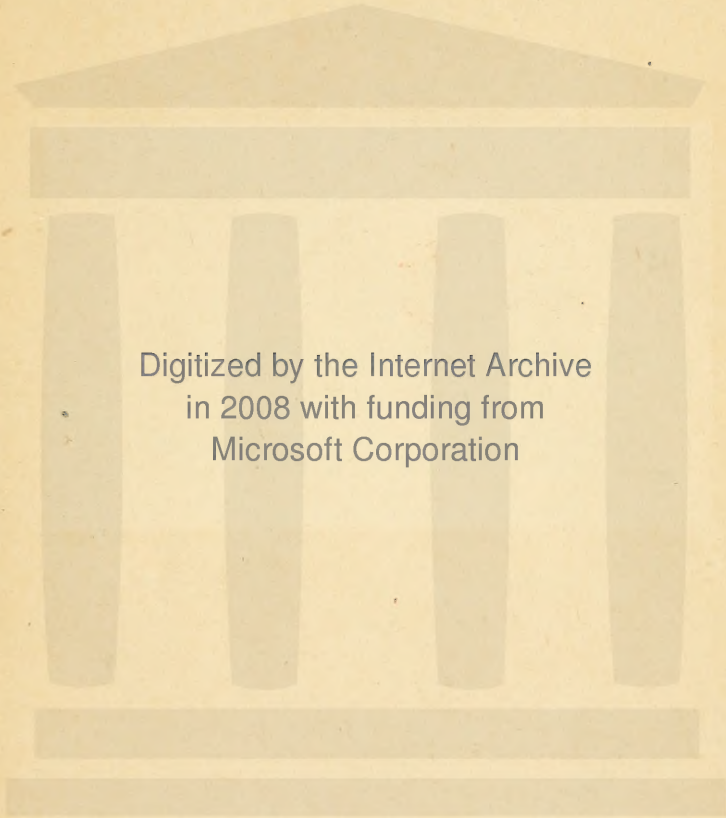
THE BIRTH AND GROWTH OF SCIENCE IN MEDICINE

THE HARVEIAN ORATION: 1920

BY

SIR FREDERICK W. ANDREWES
M.D., F.R.C.P., F.R.S.



THE BIRTH AND GROWTH OF SCIENCE IN MEDICINE

BEING

THE HARVEIAN ORATION

DELIVERED BEFORE THE ROYAL COLLEGE OF PHYSICIANS OF LONDON, OCTOBER 18TH, 1920

BY

SIR FREDERICK W. ANDREWES

M.D., F.R.C.P., F.R.S.

PROFESSOR OF PATHOLOGY AT ST. BARTHOLOMEW'S HOSPITAL IN THE UNIVERSITY OF LONDON

London:
ADLARD AND SON AND WEST NEWMAN, LTD.
BARTHOLOMEW CLOSE, E.C.

1920

Printed by
Adlard & Son & West Newman, Ltd.,
London and Dorking.

THE BIRTH AND GROWTH OF SCIENCE IN MEDICINE.

MR. PRESIDENT AND FELLOWS,—

A Harveian orator, in choosing the subject of his discourse, hesitates between two paths. He may seek to elucidate some point in the founder's life or work which has escaped the notice of previous orators, or he may take some wider theme and speak of the spirit in which Harvey carried on his labours. I have not the knowledge to attempt the first of these alternatives, and when, Sir, you did me the great honour of nomination as this year's orator, it was clear to me that I must adopt the second. Many of my predecessors in the office have been more distinguished pathologists than I am, but I believe that this is the first occasion on which the honour has been conferred upon one who is not engaged in ordinary medical practice, but is a pathologist by profession. I have to thank you, Sir, not only on my own behalf, but even more in the name of the subject which, in all humility, I represent.

The Harveian orator is enjoined to commemorate the various benefactors of the College, but considerable latitude is by custom allowed him as to the manner in which he fulfils this duty. Our College is rich in former gifts of books, pictures, silver and other valuable and beautiful possessions; our endowments in houses and lands enable the Foundation to carry out its work with ampler means. To all those who have conferred such benefactions upon the College our grateful thanks are due, and if to-day I do not formally recite the long list

of names it is because I believe that the founder of this Oration would himself have been the first to recognise that our intellectual heritage is a treasure of greater worth than material possessions. The great men of the past, to whose labours we owe the development of medical science, have been benefactors of this College, and of all that it represents, in a nobler sense. Harvey was one, and not the least, among them, and I conceive that I cannot more fittingly honour his memory than by devoting this oration to the inward spirit which has animated the progress of medical science. Many great names stand along the centuries, marking the toilsome and broken road by which our science has reached its present position, and Harvey is worthy of his company.

It is natural that, as a pathologist, I should take the more purely scientific aspect of medicine as the subject of my discourse, and it will be proper in the first place to consider the position which medicine occupies amongst the sciences. We are accustomed to speak of the "art and science of medicine," perhaps without reflecting upon where the art begins and the science leaves off. A body of facts in any branch of knowledge, however thoroughly their truth has been established, does not of itself constitute a science. Science lies in the way the facts are treated. They need to be classified and viewed in their mutual relations: then, by appropriate reasoning, it is sought to formulate the general laws which govern the province of Nature studied. The aim of science is to discover the "Laws of Nature," and in its truest though narrowest sense it is the pursuit of this knowledge for its own sake, irrespective of any practical use to which it may be put.

The primary aim of medicine is the practical one of healing the sick or preventing disease, and therefore, in the narrower sense, medicine is not a science but an art. Physiology, pathology and pharmacology are sciences in the strictest sense: medicine is the art of applying the laws established by these sciences to the prevention and cure of disease; more than this, it is the very human art

of treating the patient as well as his disease. But in a broader, and surely a more natural, sense we may regard medicine as a science. Pathology may, it is true, be pursued as an abstract subject, but in real life it is inseparable from medicine. Treatment and prevention are so intimately bound up with a right understanding of the nature of disease and of the laws which govern its course, that I refuse to separate pathology and medicine. It has too long been the fashion to limit the sphere of pathology to the dead-house and the laboratory; its field is also at the bedside, and indeed I would assert that there is no method of studying the natural history of disease which pathology may not claim as its proper province.

By Harvey's injunction I am to admonish you to seek out the truths of Nature by observation and experiment. These are two different ways of pursuing a subject, and indeed the concrete sciences have been divided into the "observational" and the "experimental": anatomy is an observational science, physiology an experimental one. The observational sciences long preceded the experimental, and in pathology and medicine, which partake of the nature of both, the experimental method is of late growth.

My aim is to trace, so far as I may in the allotted span of time, the influences which have governed the growth of our knowledge of disease, and to pursue them to their beginnings rather than to record their final results. I cannot, indeed, hope to say anything new; I can only endeavour to place before you the facts to be gathered from literature in the way in which they group themselves in my own mind.

In the first place let me consider the conditions necessary to the successful development of a science. The foremost is *liberty of thought.* Unless man is free to reason from his facts unhampered by deference to received opinion or tradition, real progress in science is impossible. The history of medicine abounds in evidence of this truth—indeed Harvey's demonstration of the circulation offers a striking instance. The second condition is *accuracy of*

observation, with patient accumulation of the facts which form the building-stones of science. The third, widely different from the preceding, is the gift of *imagination* which can frame a tentative explanation of the observed facts—a rarer faculty in the chastened form demanded by science, and perhaps a more dangerous one. The two conditions last named are seen united only in exceptional men : they were so in Harvey, who has left a clear record of the mental processes which led him to the truth. In the fourth place comes the verification of hypothesis by *experiment* in which the conditions are so controlled as to allow of more convincing conclusions than chance observations permit. And governing the whole chain of thought from its first inception there must be present that capacity for severely correct thinking, the rules for which are embodied in *logic*. Let us now see how the history of medical science sheds light on the development of these fundamental conditions.

History has been said to be the story of the influence of great men. It is true that we can associate the more striking advances in medical science with the names of individual men who stand out as landmarks in its development, but the course of history is surely swayed by influences deeper than this. A great man is the product of his times. Harvey would not have discovered the circulation had it not been for the labours of his predecessors and the intellectual atmosphere in which he lived. The great man is he who has the vision to combine the scattered facts into a harmonious whole, and who can carry conviction to others by the force of his reasoning. I shall have to commemorate such great names standing along the history of medical science, but I shall also be obliged to consider the conditions which produced them.

In his suggestive little book, entitled ' The Revolutions of Civilisation,' Prof. Flinders Petrie has pointed out that culture is an intermittent phenomenon. No civilisation in the past has proved permanent, and he estimates the average duration of any given period of culture at about

1500 years: in Egypt he traces eight such periods. The downfall is usually brought about by the invasion of a people of lower culture but greater virility, and from the mixture of the old and the new races a new civilisation is born, but only after an interval of relative barbarism—a sort of incubation period lasting some hundreds of years. The first phase of the new culture is hampered by imperfect traditions of the past: it is the stage of archaism in art, and in science it is marked by blind reliance on received opinion. In time these trammels are shaken off and the new people enters upon the unfettered exercise of its inborn genius. It acquires intellectual liberty, and now comes the phase of maximum fertility in every branch of human enterprise, lasting, perhaps, but a century or two, and followed by gradual decadence till the over-ripe civilisation is ready to fall. That this has been the course of all the civilisations known to us admits of no dispute, and Prof. Flinders Petrie adds the important observation that there is a fairly regular sequence in the development of the various branches of human activity. Art is the first to reach its highest point, and notably sculpture and architecture; literature follows later, while science is last of all in its development, and may be delayed for 500 years or more after sculpture has reached its acme. Our own civilisation offers confirmation of the truth of these propositions. Science is still advancing rapidly with us, but, as a race, we are now quite incapable of Salisbury Cathedral, of Magdalen Tower, or of King Henry VII's Chapel. Consider the recent work at Cambridge on the structure of the atom, and then go and look at the statue of Sir Wilfred Lawson on the Embankment.

But, with all this intermittence, there is none the less an upward movement of civilisation as a whole. Each new period of culture is coming to found itself more and more on that which has preceded it. In early times a civilisation, when it fell, passed more or less utterly away: its successor had to begin again from the beginning. The invention of writing has profoundly affected

the degree to which one period can influence that which comes after it. In spite of all that has been lost, our debt to classical antiquity is one that never can be measured, and with the art of printing and the distribution of books over the world it would seem impossible that any important element in our own culture should be lost to our successors when our civilisation perishes in its turn.

These considerations are of no little significance in relation to the development of medical science. We are aware of three great periods of civilisation in Europe during the past 5000 years—the Mediterranean or Minoan, with its headquarters in Crete, from 3000 to 1200 B.C.; the Classical, of which Greece was the fountain head; and the Modern or Western, in which we are still living. We know too little of the first of these, at least from the aspect of science, to enable me to say much about it; medical science, so far as we are aware, began with the ancient Greeks.

This statement requires justification, for we know that the older civilisations of Egypt and Babylonia had some acquaintance with medicine and attained a certain degree of surgical and therapeutic skill. I have spoken of Science as an endeavour to formulate the laws of Nature, and as the pursuit of knowledge for its own sake. Now the Egyptians, as Prof. Burnet has pointed out, had invented certain practical rules of mensuration, amongst others one which involved the properties of the triangle with sides of 3, 4 and 5 units respectively, but they used their rules empirically. The Greeks took this knowledge and began to study the properties of numbers for their own sake: Pythagoras proved the abstract proposition which we know as Euclid I, 47. The Greeks originated the science of mathematics. Similarly the Babylonians amassed data concerning the heavenly bodies, and arrived at a certain periodicity of eclipses, but they made no attempt, so far as we know, to formulate the laws governing the movements of the sun, moon and stars.

The Greeks absorbed the Babylonian data, and began to reason about them; in a few centuries they found out that the earth was round and floated in space, and surmised that it was only a member of a larger system of worlds; they not merely observed, but succeeded in explaining eclipses. They thus founded the science of astronomy. In the same way, as I propose to relate, they laid the foundations of medical science.

The way in which Greek history is usually taught in schools is, to my mind, a deplorable thing. If one takes up a primer on the subject, one finds it a lamentable record of petty strife and treachery, redeemed, indeed, here and there by some noble and heroic action, but conveying little of the marvellous achievements of the Greeks in the realms of thought and art. What does the Peloponnesian war matter, in comparison with the invention of mathematics and logic, with the rise of democracy, the development of the drama, or the idealism of Greek sculpture? By all means teach the school-boy what Marathon and Salamis meant for the future of European civilisation, but teach him, too, the significance of Hellenism in art, literature and science. The political failures and downfall of the Greeks may well be relegated to a tragic addendum, to warn him that no intellectual brilliancy and freedom can make a nation long successful in the absence of unselfishness and good faith.

I take it that few things have ever happened in the world so wonderful as the relatively sudden intellectual development of the ancient Greeks. Ethnologists tell us that a peculiarly happy accident of racial fusion was largely accountable for their genius. Right through the Bronze Age the dominant race in the Ægean had been that which developed the so-called "Minoan" culture—a people small in stature, active and intelligent, and with a highly developed artistic talent. Their civilisation was overwhelmed by successive waves of migration from the north: the invaders were of Aryan origin, and represented many different tribes. The Achæans, known to

us from the pages of Homer, were amongst the earlier comers; the Dorians came last, and partly drove out the already half-mingled Mediterranean and Achæan races. The Dorians seem to have contributed little to the intellectual development of future Greece; they remained more or less apart—a military people of which the Spartans were a type. The effective elements were the Achæan and Mediterranean races, the first contributing discipline, order and self-control, while intellectual acuteness and artistic gifts were brought by the southern race—a fertile combination for the growth of science. There was a long period of darkness and barbarism, lasting some four or five hundred years—a dreadful time about which history is silent. In the wreck of the old culture even the art of writing seems to have perished, and a new alphabet had to be brought into use. But by 800 or 700 B.C. the new civilisation began to dawn, and in the realms of thought the dawn was earliest, not on the mainland of Greece, but in the more settled countries round the Ægean occupied by the Ionian Greeks.

So far as we are aware, the earliest attempts at science began in Ionia some six centuries before Christ, and the name which I would first commemorate as a spiritual benefactor of this College is that of *Thales of Miletus*. I might have chosen Empedocles or Pythagoras, but we may let Thales, as the first of the succession of early Greek thinkers, stand as the prototype of the group of men who laid the foundations upon which science was to be built by future generations. Doubtless these men had acquired what they might of the lore of older civilisations, but they seem to have been the first to pursue abstract knowledge. Till their day men had been content to accept any foolish myth about the nature of the world and of the things they saw around them. The service which Thales and his successors rendered to mankind was that they rejected all fabulous tales, and began to think for themselves how things had become such as they saw, definitely reaching out after the laws which

they felt sure must govern Nature. Their great contribution to science was to establish that atmosphere of intellectual liberty which rendered science possible. It says much for the liberal spirit of that age that these men, who broke with all the cherished traditions of the past, were not, as a rule, reviled for impiety, but received universal honour. Thales was accounted one of the seven wise men of Greece.

It is easy for us to smile at the crudity of some of the attempts of these early philosophers to explain Nature. Yet they early recognised the permanence and indestructibility of matter, and one of their chief preoccupations was the search after the primary substance out of which they conceived everything to arise. Some identified it with water, some with air, and Empedocles, in the fifth century B.C. is credited with formulating the doctrine of the four elements, earth, air, fire and water, which was to dominate scientific thought for more than a thousand years. The obvious antagonism between heat and cold, dryness and moisture, early led to the doctrine of "opposites," which became one of the chief tenets of Greek medicine. Even the atomic theory can be traced back to Leucippus of Miletus in the fifth century B.C. This conception, elaborated some four centuries later in the well-known poem of Lucretius, is an interesting example of a hypothesis reached by sheer thinking, but remaining sterile for 2000 years, till established by the experimental method in the hands of Dalton. That marks the difference between the science of the armchair and that of the laboratory.

But let me now consider what the earlier Greeks did for medical science. Medicine of a sort and rude surgery must have been transmitted even through the dark ages, handed down, it is said, by special families—the Asklepiadæ—just as the epic tradition was passed along by the Homeridæ. Certain rules of surgery and the practices of blood-letting and purgation are known to be of immemorial antiquity, but for the most part the medical practice of

those times seems to have been bound up with fetish-worship and superstition. There is no evidence that Egypt had any true medical science to impart, and our knowledge of Minoan medicine is limited to the single fact that in the great palace at Cnossus there existed a system of sanitation so good that it was never equalled till the reign of Queen Victoria. We may be quite sure that the inquisitive and receptive Greek mind was quick to pick up what it could from the older civilisations, and then, in accordance with its peculiar genius, it proceeded to develop it out of all recognition. The greatest achievements of the Greeks were not in medical science: other sciences had to develop before medicine could rest upon a proper foundation; but what they did for medicine was no small thing.

Their physicians were usually philosophers, and their philosophers speculated as freely about the functions of the body as they did about the universe. Their physiology naturally reflected their views on science in general. The school of Empedocles identified his four elements with the hot and the cold, the moist and the dry, and loss of balance between these opposites was held to produce disease. Had such crude speculations been all, medicine might have owed little to the earlier Greeks. But there was much more. The Greeks were acute observers, and they began to study and to record the phenomena of disease, grouping and classifying according to the lights of the time: thus medicine entered upon its first scientific stage; it became an observational science. More than this, just as in other matters the philosophers had put away the myths and fairly tales of their ancestors, so, too, in medicine they rejected the magic and fetish-worship which had hitherto formed so large a part of practice: this was one of the greatest services rendered by the Greeks to medical science. Not that medicine became altogether dissociated from religion. Æsculapius was worshipped at numerous temples, and thither the sick were brought to receive such benefit as they might from

the rites of the god. But at such health resorts they were also subjected to other influences—careful diet, pure water, rest and cheerful associations—and when improvement occurred, the physicians had the acuteness to perceive that this simple treatment had probably more to do with the result than the religious rites.

This brings me to the second name which I naturally commemorate to-day—that of *Hippocrates of Cos*—the first great clinician of whom we have any knowledge, and one whose name will always be associated with the phase which Greek medicine had now reached. When Hippocrates was born, about 460 B.C., observational medicine had attained a considerable pitch of excellence. He doubtless imbibed the teachings of other great physicians who had gone before him, but the veneration in which Hippocrates was held by the Greeks themselves assures us that he was a man of outstanding character and attainments. We can, however, judge of him more directly. It is certain that only a small part of the Hippocratic treatises which have come down to us are from the pen of the master himself, but we may reasonably take them, as a whole, to represent his teaching, and they give us a fair idea of the stage at which the best Greek medical science had arrived in the fifth century B.C. It was a simple and rational medicine based on careful clinical observation and on a watchful study of the results which followed hygienic treatment. The healing powers of Nature formed a leading tenet of the Coan school: we may almost regard Hippocrates as the founder of sanatorium treatment. Perusal of those of the Books of Epidemics which are most certainly by Hippocrates himself, shows that he was an admirable case-taker; in the light of our present knowledge we can readily make a diagnosis from many of his descriptions. His medicine shows, of course, the natural limits of a purely observational science: it knows little of anatomy and less of physiology; its crude pathology is based on the doctrine of "opposites"; the idea of experiment as a means of

investigation has not yet arisen. Yet in spite of this the school of Cos is a landmark in the history of rational medicine. Throughout its writings there breathes a certain lofty and independent spirit, so that we feel that we must reverence Hippocrates not only as a great physician but as a great gentleman.

We look back to Athens in the fifth and fourth centuries B.C. as the golden age of Greece and the fountain-head of later European thought. It is the more disappointing to find that Athens itself made little direct contribution to medical science: the Athenians of those centuries were more concerned with metaphysical speculations than with science until, indeed, we come to Aristotle. Nevertheless it would be a grave mistake to suppose that Athens did nothing for medicine, for at this period were firmly founded some of those abstract sciences, and, above all, mathematics and logic, upon which the future development of the concrete sciences ultimately rested. I must not dwell on *Aristotle*, for he has been the theme of more than one Harveian oration, and rightly so, for his influence on Harvey was immense: probably no one man has so profoundly affected the thought of succeeding generations. Logic was essentially his creation: his works remain a monument to the genius of the Greeks, not only for careful observation and daring speculation but for correct thinking. I have at times thought it might be well if this College insisted on a course of logic for the diploma of membership.

The gradual decay in the glory of ancient Greece is usually attributed to the known historical facts—to their petty quarrels and their incapacity for combining amongst themselves. There was probably also a deeper cause—the racial fusion to which they owed their origin had passed its period of maximum fertility, and the Greeks but fulfilled the doom which ultimately overtakes every civilisation. But Hellenism did not die: what the Greeks had achieved remains as a quickening influence for all time.

In medical science the centre of interest now shifts

elsewhere, and especially to Alexandria, but it remains Greek. Alexandrian culture represents a sort of continuation of that of Athens, though, perhaps, in comparison, smacking somewhat of Wardour Street. The great creative age in art and poetry had gone by; it was a period of imitation in art, and in literature largely a time of scholiasts and commentators on the better work that had been done before. But here we have an excellent illustration of Flinders Petrie's dictum that, in each period of culture, science reaches its prime long after art and literature have begun to decline. For all the branches of science, then extant, continued to advance in Alexandria. I need hardly recall how mathematics and astronomy flourished under the Ptolemies, while in medical science the Alexandrian school maintained its premiership for many hundred years. Anatomy and physiology form a necessary basis for medical science, and, much as the earlier Greeks had done for medicine, they had lacked any adequate knowledge of these subjects. The later Greeks proceeded to remedy this defect. The practice of dissection became established, and anatomists must look back to the Alexandrian school for the foundation of their science. I must pass over Herophilus and Erasistratus, and commemorate the later Greek school in the person of its most distinguished alumnus—*Galen*.

The gifts of Rome to Europe were law, order and settled government: the Romans left us a stately literature, but to science, as to art, they made little original contribution. If we except the elder Pliny's 'Naturalis Historia,' itself largely a compendium, Rome produced no great scientific work. Roman medicine, like its art, was wholly Greek in origin: its great physicians received their training in Greek schools, and Celsus, the best-known writer on medical subjects, was not himself a practitioner of medicine. Thus, though we associate Galen with Rome, I must commemorate him as a Greek —the last and in many ways the greatest of the Greek physicians.

Nearly 600 years had passed between Hippocrates and Galen, and when we compare the two it must be remembered that Galen had the advantage of that 600 years of medical experience. It gave him a wider outlook and thus made him the better physician, though I conceive Hippocrates, considering his times, to have been the bigger man. I do not propose to dwell on Galen's eminence as a physician, though he stood far above all others of his age. His real claim to immortality may be put into a few words: he was the first to make systematic use of the experimental method in medicine, and he founded the science of physiology. He probably owed more to his studies in Alexandria than to his native school of Pergamum, for there he had the opportunities for human dissection which were denied to him later in Rome, and there, too, he must have gained his first insight into the possibilities of the experimental method. To us it seems a marvel that a man of Galen's ability, an adept in the methods which we know he used, should have failed to apprehend the circulation of the blood, for he came very near it. History is full of instances in which erroneous assumptions, so firmly held that their truth is never called in question, blind men to a truth which would otherwise be obvious. It was so with Galen, and, did we know it, it is probably true of ourselves. Nevertheless his experimental discoveries in other regions of physiology, and particularly in the domain of the nervous system, entitle him to be called the father of that science. Galen must also be credited with a great advance in pathology. The earlier Greeks had regarded internal medicine from a purely humoral aspect: the later Greeks began to recognise affections of certain definite organs, but Galen developed this conception beyond any of his predecessors. His latest treatise, 'De locis affectis,' deals with the morbid conditions of the different organs as judged from the symptoms of the patient. Dr. Payne has justly remarked that, had Galen been able to make post-mortem examinations, he might have founded morbid

anatomy. It so happened that Galen was one of the most prolific writers who ever lived, and by devious ways much of what he wrote has come down to us. It is no wonder that the works of so eminent a man should have come to occupy in later ages a position in medicine almost like that of the Bible.

For, with Galen, we come to the end of the great age of classical civilisation, and it will be fitting, before leaving it, to summarise what Greek genius had accomplished in medical science. An atmosphere of intellectual liberty had been established by the Greeks, essential to the birth and growth of science: they had developed the love of knowledge for its own sake. Their shrewd observation had transformed medicine from a medley of traditional empiricism and superstition into a natural science: they freed it from magic, and laid the foundations of a rational treatment of disease. Towards the close of their epoch they devised the experimental method and used it to found the science of physiology. Indirectly medicine, like the other sciences, owes to them the laws of clear thinking, and the development of mathematics and mechanics. Could I have selected four names from antiquity who more fully deserve our gratitude as benefactors of this College than Thales, Hippocrates, Aristotle and Galen?

When the Minoan civilisation passed away, the Greeks had been compelled to begin again, almost from the beginning. There was no such complete break between the classical period and our modern civilisation: much was handed on by direct tradition, and vastly more by written manuscript. Nevertheless, after the fall of the Roman Empire, Europe had to be re-made and to pass through its dark ages before the dawn of a new culture. The new mixture of races seems to have been incapable of intellectual achievement till the ordained incubation-period was over, and that period was at its darkest from the fifth to the tenth centuries A.D. Art was at a low ebb, and the culture of classical times was largely forgotten:

the great libraries were neglected, or in some cases destroyed, and an immense amount of the literature of Greece and Rome perished beyond recall. Medicine shared the fate of the other sciences, and what was not forgotten became debased by admixture with Eastern magic and superstition. The dominant power in Europe during this period was the Church, and although its conservatism had a wholly deadening influence as regards the advance of science, it did much to preserve the culture of classical times. The mediæval monasteries were the storehouses of learning, and though the study of pagan writings was not encouraged, there was nothing to prevent a good monk of literary tastes from making copies of ancient manuscripts. This was one channel by which some knowledge of classical medicine was handed down the dark ages, but there was another of even greater importance. In the seventh century occurred the last of the four known Arab migrations which have overwhelmed neighbouring peoples: it spread not only over Western Asia, but all round the Mediterranean. Whatever may have been the primitive culture of these Arab invaders, they presently acquired a high degree of civilisation. They were a keen-witted race, quick to assimilate the culture with which they came in contact, and this was largely Greek in origin. For some hundreds of years the Moorish Empire in Spain was far in advance of the rest of Europe in literature, in science, and in medicine. The best medical works of classical antiquity were translated into Arabic, and it is by this strange route that much has come down to us which would otherwise have been irretrievably lost. The Arabs were skilled in criticism and dialectics, but they were not great original thinkers. They left us descriptions of certain diseases unknown to the ancients, such as measles and smallpox, but medical science owes them relatively little. Their chief share in medicine was to absorb and transmit the knowledge of the Greeks.

An end came at last to the dark ages of Europe, and

in one sphere of activity after another the fetters of the past began to be shaken off. Art was the first to revive; sculpture and architecture almost reached the zenith of their development in the thirteenth century: painting took some two centuries longer to free itself from archaism. Intellectual freedom was still longer delayed: from the twelfth to the fifteenth century there was learning in plenty, but it was study devoted to what had been written in the past, not the free exercise of the mind in fearless inquiry after the truth. It is easy to blame the Church for this exclusive devotion to tradition and dogma, but the Church could not prevent the Renaissance when the times were ripe: we should rather regard the fact, with Flinders Petrie, as part of the ordained cycle in the evolution of a civilisation. Medicine reflects the spirit of these centuries: the traditions of the past were still supreme, and Galen was the god of the medical world. Men felt him to have been a better man than themselves, as in truth he was, and it was enough that Galen said this or that, or that his writings could be interpreted in such and such a sense, and there the matter ended.

And then, in the fulness of time, after more than a thousand years of intellectual slumber, men again began to think for themselves, just as the Ionian Greeks had done twenty centuries before. The Renaissance was at first literally a Revival of Learning due to the renewed study of the Greek language, and the discovery of much of the classical literature which had been hidden away in the libraries of the East. It is outside my province to discuss this great movement, which spread from Italy to England in the fifteenth and sixteenth centuries, except in so far as it influenced medical science. The first effect of the revival was to strengthen the position of Galen. It must be remembered that he was but imperfectly known in mediæval times. Much of his work had been lost, and as for what remained it is unlikely that all the spirit of the original would be conveyed by Greek writings, translated into Arabic, and later rendered into corrupt Latin.

But with the revival of Greek in the fifteenth century his original writings became accessible, and manuscripts hitherto unknown came to light. It became the aim of the scholars of the time to translate these works into polished Latin for the benefit of those unacquainted with Greek. Amongst the "Medical Humanists," as they are termed, was the Founder and first President of this College. There is no more honoured name in scholarship than that of Linacre, but it is instructive to note the difference between his mental attitude and that of Harvey little more than a hundred years later. Linacre stands for the revival of learning, Harvey for the intellectual quickening that revival was to engender. The avowed aim of the medical humanists was not the advance of medical science but a return to the uncorrupted knowledge of the Greeks: the thought and science of antiquity were still held so immeasurably superior to anything that modern times could produce that no advance was contemplated. But the seed was sown. Greek literature was the product of an original creative activity and a mental freedom to which Europe had long been unaccustomed. Men could not study it without at the same time drinking in something of the spirit in which it had been conceived and which animates it for all time. This was our true heritage in the Renaissance, and, once again imbued with this spirit, men felt at liberty to ask whether the ancients were always right, and to criticise and test their statements. The reign of mere authority came to an end and science recommenced that advance which has continued to the present day.

The first science to bear new fruit was anatomy. It was in Italy that the resurrection began, and the book written by Vesalius on 'The Structure of the Human Body,' published in 1543, set the seal upon the new method—the appeal to fact instead of to dogma. But the story of the rise of anatomy has been told so often and so well in Harveian orations, especially in relation to the organs of circulation, that I need not dwell on it.

We all know that the truth as to the pulmonary circulation was first ascertained, while it was reserved for Harvey to demonstrate the systemic circuit. The method of experiment as an adjunct to observation, instead of being delayed for hundreds of years as it had been amongst the Greeks, was now, thanks to Galen, an instrument ready to hand. And thus it came about that, when a man arose, deeply imbued with the true spirit of science, and capable of using this instrument with intelligence and an open mind, his study of the circulation was at once rewarded by a discovery of capital importance.

One does not commemorate the name of William Harvey in this oration merely from a sense of duty: he truly stands as one of the landmarks in the history of medical science. His was the first scientific discovery of absolutely first-rate importance to be made by the application of the methods and spirit now revived from ancient times: he possessed the vision, the power of imagination, as well as the needful industry and patience in gathering his facts and devising his experiments.

Harvey has left us two treatises of unequal greatness. The 'De Motu Cordis' has no need of any introductory disquisition on scientific method, for it, itself, is the method incarnate. It is the mature work of a master who is sure of his ground: it sweeps us along from one short chapter to another, each filled with accurate observation and close reasoning so that no hesitation or doubt is possible to the reader. And we feel that this is because the methods open to Harvey had been adequate to solve the problem at issue; the times were ripe for his discovery. But he also essayed to solve other biological problems for which his means were not adequate, and the 'De Generatione,' which he was reluctant to publish, is reading of a different kind. The most instructive part of this treatise is perhaps the introduction on scientific method—"Of the Manner and Order of acquiring Knowledge." Here Harvey, in his later age, sets forth the principles which had guided him, with Aristotle as his

leader, in his life's work, and we realise how truly scientific were his methods. But though these methods enabled him to correct many of the errors of his predecessors, and though the 'De Generatione' is full of accurate and curious observations and good reasoning, in comparison with the 'De Motu Cordis' it leaves us cold. No great conclusion emerges; the real problems of generation remain unsolved. And no wonder. Harvey had no microscope.* But the methods and reasoning he employed, his freedom from prejudice, his modesty—these remain a guiding light to future generations to point out the path by which science should be pursued.

With Harvey we feel that medical science has fairly entered that path. The conditions which I ventured to lay down at the beginning of this discourse as essential to scientific progress—freedom of thought, accuracy of observation, imagination, experimental verification, logical reasoning—all are exemplified in Harvey's work. I have endeavoured to trace the birth and growth of medical science up to this point, and I fear that, in the attempt to cover so wide a field in the brief hour allotted me I may have incurred the charge of superficiality. I must be content if the sketch, though superficial, is not wholly wanting in perspective. I have intentionally dwelt upon the earlier phases of scientific medicine, for my theme has been the spirit which brought it to birth rather than the triumphs of its maturity.

If you are not weary of somewhat trite observations, I will conclude by passing in brief review some of the influences which, since Harvey's day, have been most fruitful in furthering the growth of medical science. However admirable the spirit of inquiry, medicine can only employ the means at its command, and of all

* This statement is not strictly correct. It has been pointed out to me that one of the portraits of Harvey shows an instrument of the compound type. It is, however, clear from negative evidence that this imperfect microscope was of no great service to him in his researches; otherwise he would have mentioned the fact.

sciences medicine is perhaps the most complex, the most dependent upon other sciences for its development. Hence it is from outside medicine that the chief stimuli to progress in medical science have come. In saying this I would not be thought to undervalue the vast internal progress which has been brought about by clinical study. One has but to recall the mighty name of Sydenham to realise what a pure clinician can accomplish. Sydenham would have none of physiology or pathology, and we may almost wonder whether one so disdainful of science would have been pleased to know that he was the founder of Epidemiology.

There is room for difference of opinion as to the impulses from external sources which have had the most far-reaching effects upon medicine, but I would name four as of exceptional importance. They are: the invention of the compound microscope, the development of chemistry, the acceptance of the doctrine of evolution, and the discovery of the relation of micro-organisms to disease.

The microscope was invented in Holland early in the seventeenth century, but its possibilities as an aid to anatomy were not at first grasped, and it was not till after Harvey's death that Malpighi actually saw the capillaries, and the contrary direction of the blood-flow in arteries and veins. The rise of histology from that time forward has transformed our ideas of the structure of the body, and with each improvement in the microscope our horizon has widened. We have passed from the organ to the units of which it is built up, and Virchow's 'Cellular Pathology' marks an epoch in the history of medicine. To-day we are a stage further, for the inquiry is being pushed into the more intimate structure of the cell itself, in the hope of revealing the nature of the processes by which it carries on its work.

The rise of physics and chemistry has been even more fruitful for medicine. We cannot nowadays consider them separately, so closely merged have they become. We recognise the fundamental importance of these sciences

for the right understanding of physiology and pathology, by placing them at the root of medical education. Chemistry has influenced medicine from the days of alchemy onwards; Paracelsus and Van Helmont stand out as picturesque figures in its history. In England the rise of physics and chemistry began in Harvey's lifetime with those meetings of scientific men which later gave birth to the Royal Society. It must not be forgotten that the work of such men as Boyle, Hooke, Lower and Mayow practically solved the problem of respiration not long after Harvey's death—a problem second only in importance to that of the circulation—though a century was to elapse for its full meaning to become clear with the discovery of oxygen. Every advance in physics and chemistry has borne fruit for us in its turn; to-day we can almost affirm that the chief issues in physiology and pathology are to be sought in the chemical activities of the human body. These, again, are bound up with physical conditions, and there is one modern branch of chemistry, the possibilities of which are only beginning to be appreciated in medicine. If we reflect that the body, from a chemical point of view, consists almost entirely of colloidal compounds, the behaviour of which is still imperfectly understood, it will be realised that advances in colloidal chemistry are destined to throw a flood of light upon the processes of vital activity.

The doctrine of evolution has scarcely received the attention it merits as a factor in modifying the opinions of medical science. So long as it was believed that the body, with all its natural functions, had been created from the first in its present condition, there was little room for inquiry into the origin of those functions, and still less into that of morbid processes. Darwin has changed all this, as a single instance will suffice to show. Metchnikoff's studies on the comparative pathology of inflammation have taught us that this is not a diseased state, but a purposeful reaction against injury, gradually perfected in passing up from the lower to the higher

animals. Almost without our being conscious of it the idea of evolution has gradually effected a great change in the standpoint from which we view a large number of diseases, the symptoms and morbid changes in which we now understand as efforts of the body to maintain its integrity in face of the injurious agencies which threaten it. One might almost re-write pathology from the evolutionary point of view.

Last, but not least, of the great changes which have swept over medical science is that which was due in the first place to Pasteur, was carried on by Koch, and brought to triumphant practical application by Lister. The discovery of the true nature of infection has of necessity transformed the outlook of medicine and surgery, but bacteriology and its daughter science, immunology, would demand a Harveian oration to themselves.

We loosely speak of such fundamental discoveries as those I have just mentioned, as producing a revolution in medical science. It is not revolution but upward growth. With the establishment of each great principle we gain a fresh height, from which the field of science takes on a new and wider aspect, and we may be confident that we shall reach yet greater heights, to reward us with an even ampler range of vision. There is no sign that the vitality of science in our civilisation is in any way spent: on the contrary its fertility is unchecked. During the late war we saw for the first time the scientific forces of this country fully mobilised, and no previous five years have seen so many scientific problems brought to a successful issue. So forcible has been the lesson that science has gained mightily in public estimation, and research is on the lips of everyone. New facts are being gathered in, old facts are coming to be seen in a new light; we are almost bewildered by our own progress. The workers in the field of medical science are many, and it may not be given to any one of us to make an immortal discovery such as that of the circulation of the blood. But the humblest of us can work in Harvey's

spirit and bring his contribution to the building up of knowledge in the full assurance that even a single stone, if honestly and truly squared, will in due time find its proper place in the fabric.

ADLARD AND SON AND WEST NEWMAN, LTD., IMPR., LONDON AND DORKING.