

HARVEY AND GALEN

THE HARVEIAN ORATION

FOR 1896

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HARVEY AND GALEN

The Harveian Oration

DELIVERED BEFORE THE ROYAL COLLEGE OF PHYSICIANS

OCTOBER 19, 1896

BY

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Laßt fahren hin das allzu Flüchtige!
Ihr sucht bei ihm vergebens Rath;
In dem Vergangnen lebt das Lüchtige,
Berewigt sich in schöner That.

GOETHE.

THE HARVEIAN ORATION

ON THE RELATION OF HARVEY TO HIS PREDECESSORS
AND ESPECIALLY TO GALEN

MR. PRESIDENT, FELLOWS, AND GUESTS,

BEFORE entering on the immediate subject of this oration, I am reminded that the President who entrusted me with this honourable duty is no longer among us. It was Sir Russell Reynolds who, with all his graceful courtesy, offered me the post of Harveian orator, and it was to him that I looked forward to submitting the result of my endeavour to prove worthy of his choice ; but it was not to be. As this is not the first public occasion on which the College has met since we lost our late President, this is not the opportunity to commemorate formally or at any length his great public services. In Sir Russell Reynolds we knew one who, by hereditary disposition and by his own personal qualities, was, as a cultivated and scientific physician, a representative Fellow of our College. During his tenure of office he was the loyal and kindly friend of all of us, and among the distinguished Presidents of the College of Physicians his name will not be forgotten. And to you, Sir, who occupy the chair of Reynolds, I will only venture in your presence to say that you occupy the same place in our loyalty and affection ; and that I, in this position, hold myself fortunate that I have to submit my attempt towards the commemoration of Harvey to no less kind and competent a judge.

The task of composing the Harveian Oration, founded 240 years ago, becomes every year more difficult.

The objects to which Harvey himself desired the lecturer on the foundation to direct his discourse, namely, to commemorate the benefactors of the College, to exhort our Fellows and Members to search out the secrets of Nature by way of experiment, and to continue in mutual love and affection among ourselves, will never grow old. Let us never allow them to be forgotten.

The list of benefactors of our College has been enlarged during the past year by one name, of which I must now speak. Captain Edward Wilmot Williams, as the representative of our late venerable Fellow, Dr. Bisset Hawkins, has generously made over to our College the sum of one thousand pounds for the purpose of perpetuating the memory of Dr. Bisset Hawkins in connexion with the College. Nor must I omit to add that it was through the good offices and wise counsel of our friend Dr. Theodore Williams that this valuable benefaction accrued to the College. To him therefore, as well as to the generous donor, our best thanks are and will be always due, and have indeed already received formal expression in a vote of the College. The precise method in which the intentions of the donor are to be carried out is still under consideration.

The second Harveian injunction, to study Nature by way of experiment, is, I hope, not forgotten at the present day, and I feel that the breath of a Harveian orator can add little to the great forces which sustain the restless energy of modern science. But I have hoped that by bringing before you the strictly experimental researches of a great man of past times, whose services to science are not always duly acknowledged, I may by his brilliant example add some new force to the noble exhortation of Harvey.

The third injunction, to live in harmony among ourselves, needs, I hope, few words. For the harmony of our College is, and promises to continue, so unbroken that we need not emphasize, while we take to heart, the lesson which Harvey's gentle nature desired to teach us.

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It has always been the tradition, with which one would not willingly break, that Harvey himself and his great discovery should be specially commemorated on this occasion. A long series of eminent men have so ably treated of the discovery of the circulation, and its consequences, that it would be difficult to add anything to what they have given us. But still I find that the genesis of Harvey's idea, and more especially its historical connexion with the labours of the great men of antiquity who laid the foundations of anatomy and physiology, have not received the same degree of attention. Antecedents, however, no less than consequences, have to be taken into account in giving its true value to any scientific discovery.

It is generally admitted, though perhaps not always borne in mind, that no kind of knowledge has ever sprung into being without an antecedent, but is inseparably connected with what was known before. In this respect science is only like all other kinds of natural phenomena. The present aspect of the world, geologists tell us, is a necessary consequence of previous conditions and changes. The present races of animals and plants are the descendants of a long series whose origin we cannot trace. Modern civilization is the outcome of the efforts of man in all past ages to construct a social fabric. So even our modern science, which we sometimes speak of as though it were altogether a new thing, is only the final resultant of all the endeavours of men in past times to penetrate the secrets of nature. When we look back upon those strivings they often seem perverse and contradictory; men at certain periods seem to have gone backward rather than forward; we are struck less by the few grains of truth than by the great mass of what we call errors. But let us speak gently of these errors and call them rather imperfect truths, for, in science at least, the truth of to-day is error to-morrow. They are parts of a continuous evolution, in which the so-called truth and the so-called error are inseparably mingled.

Again, it seems to be sometimes thought that great original thinkers and discoverers make an exception to this

law of continuous evolution. We imagine that such men as Aristotle, Galileo, Harvey, and Newton were independent of their predecessors, that, in fact, their great work was to demolish the errors—that is, to destroy the work—of those predecessors and to start afresh. But in reality no man, even the greatest, was ever thus independent. The investigator is indebted to those who went before him, not only for the instruments of research which they perfected, but for the conclusions which they arrived at. These conclusions, whether he admits or rejects them, serve for his help and guidance. It is easy to see how a discoverer profits by the ascertained discoveries of his forerunners. It is not so easily seen that the so-called errors of those men are also of great value to him. How many false solutions of a problem are required before the true solution is arrived at! How many are, indeed, necessary elements in this final solution! I know that there are various kinds of errors, and that, while some are stepping-stones, others are stumbling-blocks; but still there is much truth in the general proposition that error is a stage in the development of truth. A certain novelist has sketched the character of a philosopher who devoted his life to writing the *History of Human Error*. Were such a work ever honestly written it would be the *History of Human Progress*. I ask your indulgence for entering on these abstract topics, because they will be found to bear immediately upon my subject, which is *The Relation of Harvey to his Predecessors, and especially to Galen*.

It will be found, I think, that after tracing the services of Harvey's own generation and that immediately preceding it in providing him with the indispensable methods and instruments of research we are led back to Aristotle and Galen as the real predecessors of Harvey in his work concerning the heart. It was by the labours of the great school of Greek anatomists, of whom Galen was the final representative (not forgetting their successors in the sixteenth century), that the problem, though unsolved, was put in such a shape that the genius of Harvey was enabled

to solve it. Harvey's debt to Aristotle was warmly acknowledged by himself, and has been frequently insisted upon, so that it is less necessary to enlarge upon that theme. But his relations to Galen and the Greek anatomists Harvey himself, for reasons which I shall presently state, was unavoidably led to put forward less prominently, and in modern times they have been greatly undervalued, or even misunderstood. It is therefore to Galen and Greek anatomy in general that I propose chiefly to confine myself. We need not fear that the result will be to lessen our admiration for Harvey or for his momentous discovery. The very contrary will be the case.

One sometimes wishes history could be written backwards ;—that we could show how the state of affairs to-day is the consequence of that which existed yesterday or the year before, and so on. The practical difficulties of such a method would probably be too great, but in the present case I should like to trace the circumstances which influenced Harvey through the two generations preceding his own, more especially as that will give me the opportunity of obeying the Harveian precept by commemorating two great benefactors of our College—Thomas Linacre, our honoured founder, and John Caius. We shall see that there was a real link of connexion between these three generations of English physicians. The relation of Harvey's work to that of his predecessors may not be immediately obvious ; but nevertheless he owed much to them, and to the schools which they represent. In fact their labours were an essential preliminary to his own great discovery.

Harvey, as we all know, was a student first at Cambridge, in the great college which owed its second foundation to Caius. He never knew Caius, who died five years before Harvey was born, but he worked under the posthumous influence of that eminent physician, and the example of a man so distinguished, and standing in such a relation to the young scholar, must have had weight in determining the aspirations and the course of study of the greatest alumnus of his college. Beyond the fact that Harvey followed

Caius's example in studying in the schools of Italy, I will only now draw attention to two of Caius's intellectual characteristics. He was an enthusiastic student of Greek medicine, and more especially of Galen, spending much time in revising and publishing some of his writings. Besides, or rather in consequence of, this bent he was keenly interested in anatomy, and founded a lectureship in his own college to promote its study. I need hardly point out how directly these facts bear upon Harvey's career as a student.

Caius stood as to time much in the same relation to Linacre as Harvey did to himself, being about four years old when Linacre died, but in spirit the earlier pair were much more intimately connected. Caius cannot have known the older physician, but he made him in most respects the model of his life, and was in the truest sense his intellectual heir. Indeed, it was in a filial spirit that he repaired the neglect of others by erecting a monument to Linacre in St. Paul's Cathedral with its well-known affectionate inscription.

We are led back, then, to Linacre, our founder, as in a sense the intellectual grandfather of Harvey, and we ask, What share had he in moulding the mind and influencing the life of the most famous of his progeny? How far did he contribute to lay the foundation on which Harvey's great work was built? The answer is that, though neither Linacre nor Caius, even through their writings, may have had any direct influence on Harvey, they represent not only the two preceding generations of English physicians, but also represent two successive stages in a great intellectual movement which was the indispensable preliminary to Harvey's work, and of which his great discovery may be called the culmination. This was the movement generally called the Renaissance, or the revival of learning, but which, for our present purpose, might be more closely defined as the 'revival of Greek thought.' Every one knows that the most important factor in the revival of learning (so far as it took place in the fifteenth century, though doubtless it began much earlier) was, beside the invention of printing,

the revival of Greek learning and the study of Greek writers in the original. This was largely influenced by the migration of Greek scholars to Italy after the fall of Constantinople, bringing with them the 'brown Greek manuscripts' which it was thought worth a journey to Italy to read and transcribe. From this arose a new Science, along with a new Literature, and, as some think, a new Theology. Mr. Goldwin Smith has finely said that at this time 'Greece rose from the dead, the New Testament in her hand.' He might have added that in the other hand was the Book of Science. It is right to give prominence to the name of Linacre because among the Hellenists or scholars concerned in the Greek revival he occupied a high and honourable place. Not less was he known as a humanist, being an elegant Latin scholar, and as such acquired a reputation which lasted far into the next century. On his public services as the founder of our College it is needless to dwell, except as a passing tribute of grateful remembrance; but a few facts from his life will help us to understand his position. Linacre was born about 1460, seven years after the conquest of Constantinople by the Turks, and a few years after the first book was issued from a European printing-press—cardinal dates, as we know, in the history of learning. After studying at Oxford he set the example, followed by Caius and Harvey, of travelling to Italy to bring home the treasures of the new learning. The records of his Italian journey show the romantic interest with which such a journey at that time might be invested. He carried introductions to the greatest scholars, such as Chalcondylas and Poliziano; he heard at Florence the lectures given by these scholars to the princes of the house of Medici; and after moving among the Italian humanists, 'himself not least, but honoured of them all,' bore off the highest laurels of Padua¹. Returning to his

¹ This is not a mere flourish. Richard Pace, Secretary of State to Henry VIII, who visited Italy and studied at Padua (probably some

years after Linacre), picked up a tradition of Linacre's brilliant exercise for his doctor's degree. In his little book, *De Fructu qui ex doctrina*

native land, Linacre occupied a unique position in his profession, for he was probably the only physician in England who had read the Greek medical fathers in their original tongue. Many honours and dignities, as we know, fell to his lot. He was physician to the King, to Wolsey, and to all the great prelates, while he directed the studies of Prince Arthur and the Princess Mary. But, more significant and honourable than these dignities, it is to be remembered that such men as Sir Thomas More, Colet, and even the great Erasmus, were in a sense his pupils as they were also his patients, for they profited by the store of Greek learning and scholarship which he had brought back from Italy. Late in life he exchanged medical practice for the priesthood, and, thus enjoying comparative leisure, crowded all his important work into the last seven years of his life. The year before his death he published a translation from Galen, which he says was accomplished with difficulty in the intervals of the painful disease *calculus*. Almost on his deathbed he must have been correcting the proofs of his last work, an elaborate treatise on Latin composition, which was published shortly after his death¹.

percipitur (Basel, 1517), he introduces a dispute between Grammar and Rhetoric as to which could claim Linacre for her own. Rhetoric admits that he cultivated grammar in his spare hours, and says his friends wondered that he, who was born for the highest things, sometimes condescended to the lowest, and disputed with some grammarian about the vocative case; but he gained a more brilliant victory at Padua. 'Contendit tum ille feliciter quia vicit; sed mallet victoriam fuisse illustriorem, et similem illi quam Patavii olim reportavit. Nam quum in gymnasio Patavino professionis artis medicae ei (ut nunc moris est) darentur insignia, publice non sine summa laude disputavit, et seniorum medicorum adversaria argumenta acutissime refellit. Tum

iuvenis quidam perquam eruditus, coepit contra argumentari. Sed Aquila, Tace, inquit, O bone iuvenis! vides ne et consyderas *hunc* nos seniores te longo intervallo procul a se reliquisse, et in disputando superasse?'

Aquila was an eminent and venerable physician, who attained the 'Galenical' age of nearly a hundred, and, as we see, finding that he and his equals were unable to hold their ground against the learning of Linacre, rebuked the temerity of the young man who ventured to enter the lists against so formidable a disputant.

¹ *De emendata structura Latini sermonis*. London, 1524. The first pages of this work treat of the *Parts of Speech*, and thus supply the clue to the quotation which follows.

Linacre has left us the example of a noble life ; he was possessed from his youth till his death by the enthusiasm of learning. He was an idealist, devoted to objects which the world thought of little use. His devotion to learning even in the arid form of grammar was hit off by his friend Erasmus in a piece of good-natured banter, which, I fancy, caught the eye of a modern poet, Robert Browning, who in his fine poem, 'The Grammarian's Funeral,' has given us the picture of an Idealist Scholar in a way which fits Linacre precisely, even if it was not meant for him. I think probably it did refer to him, as may be seen on referring to the original passage of Erasmus¹ :—

'Yes, this in him was the peculiar grace,
Still before living he'd learn how to live—
No end to learning.
Earn the means first—God surely will contrive
Use for our earning.

¹ No one knew Linacre better than his cherished friend Erasmus, who, besides many warm and sincere eulogiums, has left in his *Praise of Folly* an anonymous sketch, evidently meant for Linacre, which, being written in Erasmus's favourite style of banter, has misled persons without a sense of humour into supposing it to be meant as an ill-natured satire. It must have been seen by Linacre, and was certainly not intended to disturb the harmony of the two friends.

Folly is supposed to be speaking of the idle aims which men pursue, and says, 'One man I know, skilled in many arts ; a Grecian, Latinist, Mathematician, Philosopher, Physician, and in all these supreme, now sixty years old, who for more than twenty years has tortured himself in the study of grammar, thinking himself fortunate if he should live long enough to define properly the eight parts of speech, which no Greek or Latin has yet satisfactorily distinguished.'

'Novi quendam πολυτεχνότατον

Graecum, Latinum, Mathematicum, philosophum, medicum καὶ τὰτα βασιλικόν iam sexagenarium qui caeteris rebus omissis annis plus viginti se torquet et discruciat in Grammatica, prorsus felicem se fore ratus si tamdiu licet vivere, donec certo statuat quomodo distinguendae sint octo partes orationis quod hactenus nemo Graecorum aut Latinorum ad plenum praestare valuit. Proinde quasi res sit bello quoque vindicanda, si quis coniunctionem faciat dictionem ad adverbiorum ius pertinentem' (*Erasmii Roterodami Moriae Encomium*, Basileae, Froben. 1521, p. 251). This is the character, not of a mere pedant, but of an idealist seen from the humorous side. The reference to 'parts of speech' seems to show that the passage caught the eye of Mr. Browning, who expanded it, as we may conjecture, into the poem above quoted. Whether the reference to 'calculus,' the disease from which Linacre actually suffered, was merely accidental or derived from some other account of Linacre's life, must remain uncertain.

' Back to his book then ; deeper drooped his head ;
 Calculus racked him.
 Leaden before, his eyes grew dross of lead :
 Tussis attacked him.
 " Now, Master, take a little rest "—not he !
 Not a whit troubled,
 Back to his studies fresher than at first,
 Fierce as a dragon.

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

To anticipate for a moment, we see that the three great English physicians of successive generations all visited Italy, and each, doubtless, owed much to that Holy Land of the northern student. But they brought back different treasures. Linacre brought a knowledge of Greek and an enthusiasm for the new learning ; Caius also much Greek and Latin, with a zeal for anatomy and training in clinical medicine ; Harvey, again, a profound knowledge of anatomy, some experimental methods, and also a great enthusiasm for Aristotle, extending not only to his natural history, but to his physics and metaphysics, as we see in the *Treatise on Generation*¹.

¹ The relations of Harvey to Aristotle would be an interesting study. Harvey had evidently studied the works of the contemporary Peripatetic school in Italy, especially Cesalpino, the great Aristotelian, and Caesar Cremonini (who is referred to later on), and was probably somewhat influenced by them. In his great work anything speculative or metaphysical is so rigidly excluded that we can trace the influence of Aristotle's theoretical side in one passage only, where he assents to the philosopher's doctrine of the sovereignty of the heart, which

rules over all like a king ; and also affirms that the heart contains within itself blood, life, sensation, and motion (*De Motu Cordis*, cap. 17, Willis's translation, p. 83). In his earlier MS. lectures there is much more that is distinctly Aristotelian. He speaks of the heart as '*caloris arx et domicilium*' (*Prelectiones*, fol. 73), and of the brain as bloodless, moist, and cold—'*frigidum ut contemperaret spiritus a corde ne inflammantur*' (fol. 93)—and adopts Aristotle's dictum that man has the largest brain because he is the hottest of all animals. In the *Treatise on*

To return to Linacre. His greatest object in life, which he pursued through many difficulties, was to make the works of Aristotle and Galen accessible by means of translations to scholars in general. He formed a sort of Aristotle society or club with his friends Grocyn and Latimer for the study and translation of the philosopher, and Erasmus tells us some versions of Aristotle were lying in Linacre's desk which he hoped would be profitable to future scholars; but they never appeared. Of Galen's works he translated several, some of them long and important¹. In medicine he wrote

Generation he is still more strikingly Aristotelian. Several times he refers to and adopts the doctrine that 'innate heat' and the seminal principle of generation are of celestial origin and analogous to the essence of the stars. In one passage where, as Dr. Church has ably remarked (in the Harveian Oration, 1895), he no longer ascribes (with Aristotle) the innate heat to the heart, but refers it to the blood, he still only extends the Aristotelian doctrine by affirming that in the blood itself there is a nature or soul superior to the forces of the elements and analogous to the essence of the stars (*respondens elemento stellarum*), a phrase used also by Cesalpino. A little further on, he compares the influence of the blood on the parts of the body to that of the superior heavenly bodies, especially the sun and moon, on the inferior. It seems as if Harvey, in spite of Copernicus and Galileo, was still living under an Aristotelian heaven and remained till the close of his life a staunch Peripatetic. This, I suspect, was the main reason for his want of sympathy with Bacon, which has often been remarked. For it was Bacon's avowed aim to destroy the supremacy of Aristotle; and nothing could have been more repugnant to Harvey than this.

¹ That Linacre had no superior and hardly an equal as a translator of Galen and Aristotle is evident from the numerous tributes paid him by the most eminent scholars of his time. Erasmus says that in Linacre's lost versions of Aristotle the language is so good that the original hardly equals it in grace ('ut Aristoteles vix in suo sermone parem habeat gratiam'), and that Galen, in Linacre's translation, speaks better Latin than he had before spoken Greek. Aldus Manutius, the great Venetian printer, pays Linacre high compliments, wishing that the Italian physicians would learn to write Latin with the same classical elegance. Budé (Budaeus), the first Greek scholar in France, ventures to prophesy that, from Linacre's versions of Galen, Britain will become as famous as was, of old, Galen's own birthplace, Pergamus. He contrasts Linacre's classical severity of style with the careless licence of contemporary (Latin) writing.

This last remark touches the only complaint made against Linacre's style: that it was too severe as compared with the current Latin of physicians and scholars, and so too difficult. But a judgement passed on Linacre after his death, and therefore free from the suspicion of

nothing original, and the above constitutes the life's work of this ardent and indefatigable scholar. We need not ask what the value of his positive achievement was, for it was curtailed by external circumstances and also by his fastidious accuracy, which made it difficult for him ever to think any work perfect enough to be published. But it may be asked, Was the *aim* which Linacre and his fellow-humanists set before them sufficiently important? Was it anything more than a matter of philological interest to revive and translate the Greek medical and philosophical classics? I think it was a worthy aim, and was justified by the event, for out of this work of the scholars grew the scientific movement, and out of this movement, in anatomy and botany more especially, was developed the first possibility of a scientific medicine. To show how these things happened would take a long time; I can only give a brief sketch of the position of the Greek fathers of medicine in Europe during the Middle Ages.

During what are called the Dark Ages the tradition of ancient medicine and science had been in the Western Empire completely broken. Galen and Hippocrates may have been known by name, but were quite inaccessible to physicians, as Greek had been forgotten even as a learned language, and Latin versions, if such had existed, were quite lost. When the medical classics came back to Europe it was by a circuitous route and through the medium of

being influenced by private friendship or a spirit of flattery, by a very competent scholar, Leonhart Fuchs, disposes of this criticism. Fuchs, in bringing out a new edition of Linacre's translation of Galen *De Sanitate* (Tübingen, 1541), refers to the warm eulogium passed on Linacre's grammatical works by a still greater scholar, Melancthon, and says to add more in his praise would be only bringing water to the ocean. He places Linacre for his

knowledge, both of Latin and of Greek, above all the other translators:—'*Hoc dixisse satis est, Linacrum diligentia et orationis puritate omnes post se reliquisse interpretes.*'

Many other testimonies might be quoted. I have given the above to show that Linacre is placed in the front rank of the 'Medical Humanists,' not only on the strength of our collegiate loyalty or patriotic sentiment, but by the verdict of European scholarship.

another language—the Arabic. The Arabian Mussulmans, when they possessed themselves of the old Greek settlements in Asia Minor, Syria, and Egypt, assimilated the learning and science of the Greeks with extraordinary intellectual ardour and perseverance. With the help of the Armenians and Syrian Christians, among whom the traditions of Greek science still survived, the chief Greek scientific writers, Aristotle, Galen, Hippocrates, with many more, were translated into Arabic, and thus were laid the foundations of the brilliant civilization and literature of the Arabs to which Europe afterwards owed so much. It had been said in old times that conquered Greece took her Roman conquerors captive, and now for the second time the Greek genius asserted itself and became supreme over the warlike races whose arms it was unable to resist. The Arabian scientific literature was thus founded mainly on the Greek. It was of enormous extent; what now survives is but a fragment. The philosophy and physics of Aristotle, the geometry of Euclid, the astronomy of Ptolemy, the medicine of Galen and Hippocrates, were all there, along with the writings of Arabic authors, Avicenna, Rases, Serapion, and many a lesser name, whose works were mainly founded on those of the Greeks, but with certain important additions. In mathematics, as is well known, the Arabs surpassed their teachers; in medicine, especially in pharmacy and in the recognition of new diseases, they added much that was new; though in anatomy they went backward rather than forward.

In the eleventh and twelfth centuries, through causes which need not now be traced, this great treasury of science became available for the European world by the translation of the Arabic literature into Latin. The first of the school of translators who performed this great service to medical science, Constantine, called the African, says expressly, in the preface to one of his versions of Galen from the Arabic, that he undertook it because no work of Galen's existed in the Latin language. The task was continued more

especially in Mohammedan Spain, by a band of scholars gathered from various countries of Europe.

Gradually a large part of Greek science and medicine, with the Arabic comments and compilations, was put into Latin, and a knowledge of it became diffused through Europe. It is well known that a great stimulus was thus given to European thought. To this was due the first scientific revival, associated to us with the names of such men as Roger Bacon and Albert the Great. And in our own subject the Arabic version of Greek medicine thus presented was the foundation of all medical knowledge through the Middle Ages. But among all these writers two names were always conspicuous, Aristotle and Galen, both of whom the Arabs honoured almost to adoration, and who, largely for this reason, took a corresponding position in the mediaeval world. It has often been said that, while Aristotle reigned supreme over the schools, Galen was the autocrat of medicine, rulers whose authority it was almost impiety to question. Hippocrates would be named as the master of Galen, but was certainly little read. A great crowd of Arabian and modern writers formed the court and retinue of the monarch Galen, and, as may happen in actual life, had in many cases more influence than the titular sovereign. Chaucer has given us in his portrait of the Doctor of Physic a good notion of the library of a mediaeval physician, in which, as we see, the Greeks, the Arabians, and the moderns, or *Neoterics*, were all represented:—

‘ Well knew he the old Aesculapius
And Dioscorides, and eke Rufus;
Old Hippocras, Hali, and Galien,
Serapion, Rasis, and Avicen;
Averroes, Damascene, and Constantin,
Bernard, and Gatisden, and Gilbertin¹.’

¹ *Canterbury Tales*, The Prologue. —In this remarkable list the writings assigned to AESCULAPIUS may safely be dismissed as mythical. The name Asclepius appears, however, as that of the author of some

mediaeval MSS., perhaps confounded with Asclepiades. DIOSCORIDES, the great botanist, whose work on *Materia Medica* was the standard for centuries, need only be mentioned. RUFUS of Ephesus was a Greek physician

The mediaeval world was thus in a sense possessed of the chief Greek medical writers; and, if this was so, one asks why Linacre and the humanists thought they were rendering such an important service to medicine in re-translating Aristotle, Galen, and Hippocrates from the original Greek. The fact was that the doubly translated versions of the Greek classics had, as might be expected from their history, many defects. Their style was considered barbarous, and, from the ignorance of the translators,

of Alexandria in the time of Trajan. His works have survived only in fragments, and must have been very imperfectly known in the Middle Ages. HIPPOCRAS and GALIEN require no comment. HALI was probably Haly Abbas, an Arabian writer whose work, called *Liber Regius* or *The King's Book*, was in a Latin version very popular. But there was another Haly, Haly Rodoan, whose commentaries on Galen were translated into Latin and read in the Universities. SERAPION was the name of two Arabian physicians, an older and a younger. The former wrote a work on Therapeutics, called *Breviarium*, translated by Gerard of Cremona; the latter a treatise on *Simple Medicines*, which was the foundation of many later works of the same kind. They were very likely confounded. RASIS and AVICENNA, as the most celebrated of the Arabian physicians, require no explanation. AVERROES, one of the latest Arab physicians in Spain, is best known as a philosopher and exponent of Aristotle, but his medical work, called the *Colliget*, was also popular in the Middle Ages and frequently printed in later times. DAMASCENE means 'Janus Damascenus,' under whose name appear certain treatises now ascribed to the older Serapion or to Mesua. But the Middle Ages doubtless regarded

him as a distinct author, and a small collection of *Medical Aphorisms* with his name appears to have been a popular book. CONSTANTIN was Constantinus Africanus, referred to elsewhere as the earliest translator of Arabic medical works into Latin. But he also brought out works in his own name, of which the Arabic origin was very imperfectly acknowledged, especially the well-known *Pantegnum* or *Pantegni*. BERNARD is Bernard of Gordon, a Frenchman, Professor of Medicine at Montpélier, stated by Haeser (but without authority) to have been a Scot. His work, the *Lilium Medicinæ*, was written in 1307. GATISDEN is John of Gaddesden, the well-known English physician of the fourteenth century, author of the *Rosa Anglica*, a handbook of medicine. He might have been almost or quite a contemporary of Chaucer. GILBERTIN means Gilbertus Anglicus, the earliest medical writer of English name. He was in the Crusades with Richard Cœur de Lion, and wrote a *Compendium Medicinæ*, which was largely borrowed from by Gordon and Gaddesden. The whole list is very curious, showing, if it is to be taken literally, that the Doctor of Physic was a man of wide reading; or, at least, that Chaucer's own knowledge of such literature was, for a layman, not inconsiderable.

often quite unintelligible. To the mediaeval practitioner who wanted an authority to quote from rather than to understand, this defect was less conspicuous. Then many of the best Greek works were either untranslated or practically unknown. It has been said that many a mediaeval schoolman called himself a staunch Aristotelian though he knew no more of the master than two short logical treatises¹, and many a mediaeval physician who swore by Galen often went no further than his smaller therapeutical work known as the *Liber Tegni*, or *Ars Parva*. Moreover, as time went on, the popularity of the translated Greek works evidently diminished, while Avicenna and other Arabians became predominant, especially in the Universities². Along with them the mediaeval compilers and copyists known as the Arabists or Neoterics (whom Harvey is recorded to have spoken of with great contempt) gradually became the most popular of all, being naturally more easily understood by their contemporaries. The scholars began to complain that the Arabians and their followers (the Neoterics and writers of so-called *Practica*) reigned in all the schools, while the pure fountains of Greek medicine were neglected³. Linacre

¹ Sir Alexander Grant's *Aristotle*, 1877, p. 59.

² Mr. Hastings Rashdall, in his most valuable *History of the Universities of Europe in the Middle Ages* (Oxford, 1895), has given a list of the medical books prescribed for study in the University of Montpellier. He observes: 'In the books prescribed by Statute in 1309 and 1340 the works of Galen predominate over Avicenna. A later series of documents, extending from 1488 to 1555, show a greatly increased proportion of Arabic books. In 1494, of eight courses, five are upon Avicenna, two upon Galen, and only one upon Hippocrates. It is not till 1534 that the tide begins to turn, under Renaissance influence, in favour of the Greeks again' (vol. ii. pp. 117, 123).

³ Janus Cornarius (Hagenbut), an eminent scholar and physician, thus expresses himself in 1535: 'Et sane consultum esset ut omnes publicae scholae semel agnito errore, omnium Arabum tum Italicorum ac Gallorum barbarorum medicorum opera, aut potius onera quorum iugo non aliter quam vilissima servitute gravissime premuntur, excuterent et exterminarent, et se Hippocrati vero artis medicae Timotheo formandos concrederent.

'At vero non penitus desperandum quando nuper adeo una Florentina Academia resipiscendo aliquando etiam aliis spem nobis exhibuit, quae excusso Arabicae et barbarae servitutis medicae iugo, ex professo se Galenicam appellavit et profligato barbarorum exercitu, unum totum et

and his fellow-humanists doubtless thought that if they could return to those uncorrupted springs and present the best works of antiquity in a classical form without barbarous corruptions medicine might go back to the glory of ancient Greece, and Hippocrates and Galen have worthy modern successors. In a certain sense they were right, though the ultimate success of their efforts came in a different form from what they anticipated.

At all events the revival of the Greek medical classics led to a declaration of war against the Arabians. With some enthusiasts it became a sort of crusade in which, strangely enough, Hippocrates and Galen were counted on the Christian side. One fantastic writer, Symphorien Champier of Lyons, imagines that St. Luke, the Evangelist Physician, whose day we commemorate in this meeting, by his intercession with the Almighty secured divine aid for the holy war which was intended to liberate the heroes of Greek medicine from their captivity among the infidels¹.

solum Galenum, ut optimum artis medicae authorem, in omnibus se sequuturum pollicita est. Quod quum fecit non exclusit utique Hippocratem super cuius scripta . . . omnia Galeni opera sunt extracta' (in the introduction to *Marcellus de Medicamentis*, published in the collection called *Medicae Artis Principes*, by H. Stephanus, Paris, 1567).

¹ *Symphonia Galeni ad Hippocratem*, &c., Lyons, 1528 :—' Non possum non indolere tantam vecordiam in nostrae disciplinae professoribus, tot seculis viguisse: ut reiectis purgatoribus literis, hoc est Graecis Romanisque, sordidissimas nebulonum quorundam nenias, tanquam coelitus demissas, excaeperint. Indignum facinus, nullis bobus, nullisque victimis expiandum. Iam eo insolentiae ac temeritatis devenerant Arabi principes, ut nobis medicam artem funditus auferre audacissime conarentur; quandoquidem castra

solventes in Graecos et Latinos omnem belli impetum convertebant, multaque millia processerant, cum Deus Opt. Max. (cuius est hominum repente et consilia et animos immutare) ut auguror sanctissimi Lucae precibus et orationibus flexus, auxilios milites demisit, qui obsidione miseris, Hippocratem, Galenum, Dioscoridem, Paulum Aeginetam, et nostrum Celsum Cornelium, iam deditionem cogitantes, eriperent ac liberarent; idque quanta sit confectum diligentia, in confesso est. Hippocrati non pauci auxilio fuere, Galeno ab Arabum principe oppresso strennue adfuit Vicentorum dux [Nicolaus Leonicensis]: praeterea ex Gallia Copus, ex Anglia Linacrus, bone deus! quo studio, qua alacritate. Porro Dioscoridi Gallorum virtus ac ferocia, Venetorum prudentia, Florentinorum divitiae opem tulerunt. Qua propter factum est, ut disciplinae omnes multo purga-

These were extravagancies. The scholars, however, had more serious views, so that in about one generation, or say, roughly, by the middle of the sixteenth century, a large number of physicians had adopted the revived Greek medicine in preference to the Arabian, though the older school was not at all superseded.

Now it is noticeable that the name which the new school adopted and was called by was Galenical or the Galenists. A small society of young physicians in Florence called themselves, in imitation of the well-known Platonic Academy, the Galenical Academy of Florence. Our own College, one of the first-fruits of the Renaissance, was, as might be expected from its history, strongly Galenical. This revival of Galenical medicine, then, was the work accomplished by the school and generation to which Linacre belonged, the first stage of the Hellenic revival. We may conveniently connect it with the name of Linacre, but of course there were many others associated in the work, as Copus of Paris, Winter of Andernach, Leonicensis in Italy, and Cornarius (Hagenbut) in Germany. It was assisted also by such men as Michael Servetus, the theologian, and François Rabelais, the great humorist. I have called this school elsewhere the Medical Humanists.

Now it might be thought that the only result of this change would be to confirm the rule of Galen more strongly than ever. New Galenism would only be mediaeval Galenism 'writ large.' To a certain extent and for a short time this was the case. Galen was still thought infallible. If any error was detected in his anatomy it was said either that the text was corrupt or that the structure of the body had changed since his time. The history of our own College shows that Galenical orthodoxy could rival the

tiores, ac synceriores in lucem prodierint, et ut tanta generi humano commoda accesserint, ut qui olim Arabs medicus unum aut alterum sanitati restituisset, nunc veritate patefacta, decem posset.'

(p. 46.) 'Lector amice, abducito te

quantum potes ab Arabum lectione, qui omnia depravarunt. Viros autem doctos in colloquium ascisce, in primis autem Hippocratem et Galenum facito tibi familiares. Hi tibi habendi sunt semper in sinu nocturna manu versandi, versandi diurna.'

theological in its rigour. But this was not for long. When the leaven had had time to work, and a second generation of Galenists had assimilated the new doctrines more completely, a totally different spirit began to prevail. All over Europe this phenomenon presented itself, that the medical humanists and Galenists, especially those well skilled in Greek, were turning to the investigation of nature. The sciences of anatomy and botany were especially cultivated by them, and, it would seem, by them alone. Clinical medicine owed its revival to the Galenists. It was evident that the revived Hellenism, so far from perpetuating the reign of dogma, had an inspiring and vivifying influence. This spirit of independent investigation was the special note of the second generation of the medical humanists, who belonged to the second stage of the Greek revival, a period and school sufficiently denoted for us by the name of John Caius, but including other and greater names which must be briefly referred to.

Let us first trace the rise of anatomy. One of the earliest anatomists at this time was Jacobus Sylvius, professor at Paris, an ardent student in the original Greek of Galen's works, in which he would see no error, but also an independent dissector. Among his pupils were Servetus, a typical scholar of the Renaissance¹; Charles Étienne or Stephanus, belonging to the family of printers of that name, renowned for their learning; and the celebrated Vesalius, who was an ardent Greek scholar. Caius has told us how, when he lived in the same house at Padua with Vesalius, the latter would bring out his Greek manuscripts to clear up some passage in Galen or some difficult point

¹ Servetus, under the pseudonym of Villanovanus, wrote a little book called *Syruporum universa ratio, ad Galeni censuram expolita*, Paris, 1537. In the preface he thus speaks of Galen: '(Galenus) renascitur vero felici nostro seculo, ut seipsum turpius deformatum in pristinum candorem restituens illustret; ut ab

Arabum copiis occupatam arcem, velut postliminio reversus, eripiat; et ea, quae corruptis barbarorum sordibus fuerant conspurcata, repurget. Quae omnia, cum sint liquido a recentioribus demonstrata, non est quod ego, causis illorum me immiscens, hic referam, aut eorum dictis sententiis calculum adiciam.'

in anatomy¹. Vesalius has been chiefly praised for correcting the errors of Galen, and rightly so praised. But his researches were based upon the system which he destroyed, and, though it is rash to say what might have happened had things been different, it is hard to see how anatomy would have arisen when it did, had Galen's works perished. What anatomy there had been in the Middle Ages from Mondino to Berengario Carpi was based on rude compilations of anatomy derived from Galen; but when his works were studied in the original we see the difference: modern anatomy began. Even to this day every student who goes down to the dissecting-room, his text-book in his hand, has reason to be thankful that in the fifteenth century men began to read Greek manuscripts.

Botany and the allied science of drugs owed their renovation to the revival of Dioscorides and in a minor degree of Galen. The great German herbalists, whose beautifully illustrated works superseded the rude herbals of the Middle Ages, were all Greek scholars; some, such as Fuchs, original and learned editors of the Greek classics. The works of the Italian Matthioli, the most popular of all books of plants, were based on Dioscorides. Cesalpino, considered the first botanist of his age, was a profound Aristotelian scholar. Conrad Gesner, the first naturalist in a wide sense since Aristotle, was, at the same time, Professor of Greek and an editor of Galen. Nor was this activity confined to men of eminence. The young physicians of the Galenical Academy at Florence, before referred to, thus describe their pursuits. I give you nearly their own words. In the winter they studied from Dioscorides the history and forms, and from Galen the uses, of plants. So soon as the season permitted and the snows began to disappear from the Apennines they made excursions into the country and on the mountains to gather herbs useful in medicine. In this way they hoped to restore the ancient medicine of Hippocrates and Galen, and thus only they thought could

¹ See *Galenii libri aliquot, per Joannem Caium*, Basel, 1544, p. 286 and elsewhere.

they become worthy to be called true Galenists¹. The story is everywhere the same. The Galenists were the students of nature, which indeed need not surprise us, since there was no more genuine student of nature than Galen himself. Thus modern natural science grew out of the ancient science of the Greeks, and in what way it could have arisen otherwise is only a matter of speculation.

Clinical medicine may be thought to be that department in which the study of the ancients could be of the least use, and in which observation alone, without any reference to books, would have been the surest guide. But here, again, we find that the Greek scholars led the way. Da Monte (Montanus), first distinguished by his editions of Galen, was the earliest clinical teacher of medicine in the modern sense. His lectures at Padua attracted crowds of students from all parts of Europe. Yet Da Monte's method of learning and teaching medicine, on which he wrote special books, was avowedly based on Galen. His pupil, our own John Caius, followed in his steps. Caius was a zealous

¹ This society issued a little book which I have not found mentioned in any history of medicine, but which is interesting as a sign of the times, entitled *Novae Academiae Florentinae opuscula, adversus Avicennam et medicos neotericos qui Galeni disciplina neglecta barbaros colunt* (Lyons, 1534, 8vo). It contains a dialogue called *Barbaromastix*, in which a young Galenist defends his principles against adherents of the older school; also a treatise *adversum Avicennam*, and another *adversum Mesuem et vulgares medicos omnes*. The society does not appear to have been a large one; not more than four members can be distinctly traced, and none of these appear to have become eminent. In the dialogue it is needless to say that the older physicians have the worst of the argument; and it is insinuated that they cared for nothing but money and notoriety, considerations to which the young Galenists

were quite superior: a distinction between young and old physicians which will probably continue to be drawn so long as physicians exist. 'Ideoque per totam hanc hyemem coepere ex Dioscoride historias et vultum plantarum observare; ex Galeno vero earum vires: uterque enim liber iugiter eis praesto erat. Porro ut oculata fides dictis attestaretur, saepius rura montesque petiere: Novissime vero cum primum per nives licuit, dum alii notas domos salutant ac nobilium exosculantur dextras, alii convalescentes nedum aegros crebra visitatione fastidiunt, alii negociosos se populo ostentant, ac generosa per urbem mula vehuntur, purpurati, quasi spectaculum aliquod populo praebituri; dum alii demum modis omnibus lucro inhiant; hi Apennini iuga montesque peragrunt; atque adeo profecerunt, ut plantas plurimas ex nobilissimis et suscitarint et ad usum verterint' (p. 10).

editor and commentator of Galen, and supplied emendations of his text, which I am told are still valued. He also wrote a *Methodus Medendi* according to the system of Galen. But it was Caius again who made in his admirable works on the Sweating Sickness the first original contribution to clinical medicine of which our country can boast. Indeed, the best of the numerous writings on this disease were due to men who were distinguished for their scholarship. The same was true of syphilis, a disease in which the direct teaching of the ancients could be of no service, but of which men trained in Greek scholarship, such as Leoniceno of Vicenza and others, whom it would be tedious to mention, have left the best descriptions.

The study of Galen again led inevitably to that of Hippocrates, the great master of clinical description. Cornarius and many of the great humanists edited and translated his works; Rabelais gave lectures at Montpélier on Hippocrates and Galen, which we may hope were lively¹. These labours, together with the long-forgotten work of Celsus, prepared the way for the revival of Hippocratic medicine in the seventeenth century, with which will always be connected the illustrious name of Sydenham.

It will then appear that the revival of medicine in all its departments was essentially a revival of Greek science. For the third time in history the Greek spirit gave new life to the intellectual progress of another race; as it had before to the Romans and then to the Arabs, so now to the modern Europeans. Out of this great revival grew the new birth of medicine, which through the scholars and the anatomists led up to what was in anatomy its culminating point, the

¹ Rabelais lectured in 1531. In the next year he published the subjects of his lectures, viz. the *Aphorisms* of Hippocrates, and the *Ars Medica* of Galen, with other treatises, in Latin, and a new recension of the *Aphorisms* in Greek. They form a tiny volume beautifully printed by Gryphius of Lyons. Rabelais himself was apparently the

author of two Latin verses on the title-page—

'Hic medicæ fons est exundantissimus artis.

Hinc, mage ni sapiat pigra lacuna, bibe'—

and a Greek epigram.

(*Hippocratis et Galeni libri aliquot, ex recognitione Fr. Rabelaesi, Lyons, 1532.*)

great discovery of Harvey. With his momentous innovation the wave of the Greek revival had spent its force, and the era of modern medicine began. But still Harvey was in an intellectual sense the heir of Aristotle and Galen.

If the sketch which has now been given of the two generations antecedent to Harvey be correct, his discovery of the circulation was the climax of that movement which began a century and a half before with the revival of the Greek medical classics and especially of Galen; for without Galen's insistence on the all-importance of anatomy in every branch of medicine and surgery the anatomical revival would probably never have taken place. What honour or gratitude has Galen received for this signal service? In modern times scanty praise or none. The great physician whom Harvey speaks of as *divinus ille vir* seems to be often thought good for little better than to point the moral of erroneous science. In some modern works, nay, sometimes even in a Harveian Oration, we hear only of the astounding errors of Galen. There is, perhaps, no other instance of a man of equal intellectual rank who has been so persistently misunderstood and even misrepresented—a reaction doubtless from the extravagant homage formerly paid him. Some have thought it would have been better if Galen had been forgotten and the medical revival had started direct from Hippocrates. I cannot think so. In that case there would probably have been no anatomy, which is little regarded in the Hippocratic treatises, and the great discovery of Harvey might not have been made. Medicine would probably have lapsed into pure empiricism, and might not for centuries have been placed upon a scientific basis.

Still less can we wish that medicine had followed Paracelsus in his violent revolt against Galen and the ancients. Paracelsus equally repudiated anatomy; and, moreover, experience shows that blank denial and contradiction are not the best means of dealing with traditional doctrines. The school of Paracelsus, though it did some service to medicine by way of chemistry, remained a sort

of side-stream or back-water, no part of the great river of scientific progress which took its rise from the revival of learning. European medicine passed, in fact, through the same three stages which we now think necessary in medical education, of general, of scientific, and of practical training. First it was disciplined by Linacre and the humanists in accurate knowledge of the medical classics; next by the anatomists and botanists in the revived Greek sciences; and thus it was prepared for the right appreciation and study of practical medicine. We cannot wish that the order of progress should have been different.

If Harvey's discovery grew, though not immediately, out of the Renaissance or Greek revival, it will be interesting to compare his work with that of the Greeks, and more especially with that of Galen. The intervening generations of anatomists—Vesalius, Colombo, Fabricius, and the rest—added much to the older knowledge of the structure of the body, but, except in the explanation of the pulmonary circulation, little to the knowledge of physiology. On this field Harvey stands face to face with Galen, nor is there any third figure that can be compared with them except that of the founder of biological science, Aristotle himself. Galen and Harvey seem at first sight such different personalities that it might be easier to find in them features of diversity than of likeness, but there was between them at least one point of contact—their love for anatomy, including what neither of them ever conceived of as a distinct science, the study of function which we now call physiology. If Galen had written nothing else than his works treating of these subjects he might not have received almost divine honours, as he did for a thousand years; but he would still be one of the greatest anatomists and physiologists of the world.

In speaking of Galen we are impressed with a sense of the immensity of the subject. His works form one vast encyclopaedia of ancient medicine, comprising anatomy, physiology, practical medicine and surgery, therapeutics with the knowledge of drugs, and practical hygiene and professional ethics. Then we have materials towards the

history of medicine which can be found nowhere else, while nearly all that is valuable in the Hippocratic writings could be recovered from Galen. Philosophy and logic are largely discussed, though most of Galen's works on those subjects are known to be lost. No one could better deserve to be called an encyclopaedist. But what Galen most prided himself upon was his method. He claimed to have organized medical science and practice so that his disciples could find their way through the tangled maze of medicine, and compared himself to Trajan, who by improving the roads through Italy had made government as well as communication easier. Here we have the clue to the one element in Galen which is not Greek, something of the organizing and governing faculty of Imperial Rome, which he might have derived from personal acquaintance with the rulers of the Latin world¹. His ideal was rather an empire of medicine than a group of republics. This very spirit of system, while it aided his supremacy through so many centuries, is in modern eyes his weakness. For systems are essentially temporary and doomed to decay, while the objective statement of original observation will always possess a certain value. It must not be supposed, however, that Galen's works contain no original observations. There are many and of great value; but often they have to be dug out of his theoretical expositions like fossils from a rock. The other great fault which both ancients and moderns find in his works is his immense prolixity; Galen in a way confesses this. But he says, naïvely, 'If I do write long books it is not my fault; it is the fault of the other people, who will write books full of so many wretched arguments.' His obscurity often results from extreme subtlety of thought².

¹ See *De Methodo Medendi*, lib. ix. cap. 8; Kühn, x. p. 633. Galen was born 131 A.D., and died probably soon after 200 A.D. He was physician to the joint emperors Marcus Aurelius and Lucius Verus, and also to the young Commodus, afterwards emperor. He mentions

Consuls, Praetors, and other distinguished persons as being among his patients, or hearers of his anatomical lectures, and witnesses of his experiments on animals.

² *De Placitis*, iv. 1; Kühn, v. p. 360.

Few physicians or even scholars in the present day can claim to have even read through this vast collection; I certainly least of all. I can only pretend to have touched the fringe, especially of the anatomical and physiological works. Even a cursory survey, however, is enough to give a clear notion of the point to which I desire to draw special attention; his methods of inquiry, his standard of evidence and of scientific proof. In these respects I think he will not be found wanting, even judged from a modern standpoint.

Galen's great anatomical work, *De Administrationibus Anatomicis*, or manual of dissections, consists of fourteen books, of which the last five are not accessible in either Greek or Latin, but exist only in a manuscript Arabic version which has not been published. Unfortunately the lost books contain part of his account of the nervous system¹. His chief physiological work, *De Usu Partium*, might almost be called a treatise on natural theology, being intended to show the wisdom of the Creator in the adaptation of the parts of the body to their functions. These relations, he says, truly constitute the basis of a perfect theology, which is far greater and more to be honoured than the whole of medicine. For Galen, it may be observed, was a devout monotheist; he was evidently acquainted with part of the Old Testament, and had probably heard some echoes of Christian teaching. What he may have said in confidential moments about Jupiter and the Olympian deities we do not know. This theological bias gives a certain warp to the book, for, feeling bound to show the perfection of arrangements which he imperfectly understood, he was naturally led into many errors. Still, it contains a full account of the functions of all organs of

¹ The last five books of this treatise are unknown either in Greek or Latin, but exist in an Arabic MS. version in the Bodleian, which has never been published. It was one of the objects in life of our late member, Dr. Greenhill, one of the most learned physicians in Europe,

to bring out these books in a modern version. But various circumstances, and especially his fastidious standard of perfection, prevented him from completing or at least publishing his task. It is hoped, however, that his version may some day appear.

the body, as he understood them, and, in the words of Dr. Greenhill, is a truly noble work. Besides these there are smaller works on special parts of anatomy and physiology ; and one controversial book, *De Placitis Hippocratis et Platonis*, directed against the Stoics and Peripatetics (or Aristotelians), is of importance as showing his methods of proof and argument. This work is quoted by Harvey¹.

It must be remembered that Galen's own dissections were made entirely on animals, the dissection of the human body being then quite impossible. Probably he had occasionally a glimpse of the internal organs in man, but his own remarks show that it could only have been a hurried inspection. This fact is the cause of a large number of the anatomical errors detected by Vesalius in Galen's works, such as the description of a rete mirabile in the human skull, of the origin of the two carotids from a single stem, and many others. In one really important instance, that of the supposed perviousness of the ventricular septum, which is often quoted as one of his startling errors, he does apparently allow deduction to take the place of observation. It was evident that the blood must somehow pass from the right to the left side of the heart ; and, being ignorant of the long circuit by the lungs, the old anatomists inferred a short circuit through the heart itself. Vesalius, though he could find no opening between the ventricles, inferred that there must be a communication by channels too small to be visible. Probably they were confirmed in this error

¹ This treatise, though largely philosophical, and intended to show the agreement of Hippocrates and Plato in points on which they both differed from Aristotle, contains much that is important in relation to Galen's physiology. It is quoted by Harvey (*De Motu Cordis*, cap. v.). This reference, curiously enough, enables us to identify the Latin edition of Galen's works used by Harvey. In the complete Latin editions, published at Venice by the Juntine press, and at Basel by Froben

and his successors, the title of this work, *Περὶ τῶν Ἱπποκράτους καὶ Πλάτωνος δογμάτων*, was translated *De Decretis Hippocratis*, &c. But in the Latin edition printed at Paris in 1534 the title runs *De Placitis*, &c. We must conclude therefore that this was the edition which Harvey used. It appears to be somewhat rare ; but a copy is in the library of the Royal College of Physicians : whether it was Harvey's own copy we cannot say. This is not a complete edition of Galen's works.

by the occasional imperfection of the ventricular septum in the lower animals and by anatomical facts which I cannot enter upon. The same is true of the supposed anastomoses between veins and arteries which Galen saw must somehow exist, though of course he was quite ignorant of capillaries. Even Harvey concluded from deduction, not from actual observation, that the terminal arteries and terminal veins were connected. Galen's views of the heart and the motion of the blood have often been expounded and discussed. It is, therefore, unnecessary to go fully into them. I only desire to show that his methods of investigation were perfectly sound, though they led to an erroneous conclusion. His sources of knowledge on the subject were—(1) Dissection of a great variety of animals, mammalia (including at least once an elephant), birds, fishes, and reptiles. He says cautiously that he did not dissect such creatures as gnats, flies, bees, ants, and worms, because, seeing what mistakes anatomists had made in dissecting larger animals, he thought they would be likely to go still more wrong in the case of these small creatures. (2) Elaborate dissections, in the modern way, continually repeated, of those animals most resembling men, especially apes. (3) Observation of the heart and vessels in living animals which he opened for the purpose. He speaks, also, more than once of the case of a boy in whom the chest walls were deficient from the results of an accident, so that the movements of the heart could be seen. (4) Numerous experiments on living animals, made in his time with less reserve than at the present day. These experiments, though not always leading to correct conclusions, were extremely well contrived and quite scientific in their plan.

Of course Galen had a large body of anatomical knowledge behind him, derived from the Alexandrian anatomists and their successors, but he never quotes any of their statements as authorities, relying entirely on his own observations and demonstrations. Had he quoted those anatomists who had actually dissected the human body, he would probably have often been more correct, according to modern

knowledge, and might have avoided some of his more serious errors ; but his resolute independence forbade him to describe what he had not seen. I quote a few instances to show his method of argument.

The most important error of Galen and the old anatomists was no doubt that of attributing the origin of all veins to the liver. Nothing was a greater hindrance to a correct idea of the circulation. But this, as a *prima facie* view, was very natural. When we open the body after death has taken place by the ordinary asphyxial method we find all the veins full of blood, and all apparently communicating with the liver, the systemic veins by the hepatic, the portal system separately. Moreover, the connexion of the umbilical vein with the liver in the foetus was also noticed. This view was not universally accepted. Galen's first instructor in anatomy, Pelops, taught that all blood-vessels originated in the brain—a view which the scepticism of the pupil even at that early age refused to accept¹. The doctrine of Aristotle was that all blood-vessels originated in the heart, the vena cava and its branches supplying the right side of the body, and the aorta and its branches supplying the left side. Aristotle's views were maintained by contemporaries of Galen, whose answer to them was that there was one system of veins unconnected with the heart—namely, the portal system, which communicated only with the liver. 'This,' he says, 'I have demonstrated to those desirous of knowing the truth, and they have been astonished at the error of those who maintained that all veins came from the heart².' Galen's argument is perfectly sound from his facts, though it confirmed him in an erroneous conclusion. What Aristotle's answer would have been we do not know. The Peripatetics, the followers of Aristotle in Galen's time, seem to have had no answer except *a priori* arguments ; in fact, Galen's argument was never answered except by Harvey.

It is well known that Erasistratus and all anatomists

¹ *De Placitis*, lib. vi. cap. 3 ; Kühn, v. p. 527.

² *Ibid.*, cap. 5 ; Kühn, v. p. 542.

before Galen, except Aristotle, maintained that the arteries contained only 'spirit' or air, not blood. Galen proved that they contained blood, not only by the familiar experience of blood flowing from a cut artery (which the older anatomists explained by a supposed anastomosis between veins and arteries), but by placing two ligatures on an artery and dividing the vessel between them, when, of course, only blood would be found. He also inserted a fine cannula into the left ventricle of the heart during life, and showed that blood immediately flowed out without a moment's interval in which the supposed spirit might have escaped¹. This, he says, he demonstrated to many persons who were incredulous on the subject. Galen clearly states that the bright-coloured, thin, subtle, spirituous (in modern phrase arterial) blood formed in the left ventricle by mixture with 'vital spirit' concocted in the lungs with the help of the air, was violently carried by the arteries all over the body². If we put vital air or oxygen for vital spirit it approximates strangely to the modern doctrine, though the anatomical errors are obvious and need not be dwelt upon. At the same time, the air returning to the lungs was supposed to carry off and send out in expiration what was, as it were, burnt up, smoky, or sooty matter. If we put, for 'smoky,' 'carbonaceous,' we have a near approach to a theory of respiration which was in vogue about fifty years ago³.

It seems strange to us that the ancients should have supposed spirit and not blood to be conveyed from the lungs to the heart by the pulmonary veins. But it should be remembered that after the ordinary asphyxial mode of death, when the heart is healthy, the left auricle and pulmonary veins are usually collapsed and empty, and would therefore have been supposed to contain, during life, air which had escaped. It is otherwise in the living animal, and it was Colombo⁴ who first proved, by actual experi-

¹ *De Placitis*, i. cap. 5; Kühn, v. pp. 182-4.

² *Ibid.*, vi. cap. 8; Kühn, v. p. 572.

³ *De Usu Partium*, vi. cap. 2;

Kühn, iii. p. 412.

⁴ Realdus Columbus, *De Re Anatomica*, Venetiis, 1559, p. 261. Servetus had arrived at the same idea by induction.

ment on the living heart, that they conveyed blood from the lungs. It seems curious that Galen, who was so fond of experiment, never tried a like experiment on the pulmonary veins. Galen's knowledge of comparative anatomy enabled him to confute Aristotle's statement that large animals have three cavities in the heart whilst small animals have only two, of which several explanations have been suggested. The horse, he says, has no more than the sparrow, nor the ox than the mouse¹. He found the right

¹ *De Usu Partium*, lib. vi. cap. 19; Kühn, iii. p. 442.

This strange error of Aristotle as to the number of cavities in the heart has given rise to much discussion, and several explanations have been proposed. The ancient anatomists, and indeed modern anatomists, at least as late (I think) as the end of the seventeenth century, never thought of the auricles as *cavities of the heart*, but only as the terminations of the vena cava and pulmonary veins respectively (the term 'auricle' being confined to the auricular appendix), and separated from the heart proper by the mitral and tricuspid valves on the two sides. Harvey also speaks of the auricles as distinct from the heart (see Willis's translation, *De Motu Cordis*, p. 29, note). Hence for them the only possible interpretation of Aristotle's statement was that he intended to say that the heart of large animals had three *ventricles*. Vesalius explains the error thus: that, the upper part of the left ventricle being concealed by and rising up behind the right (anterior) flap of the mitral valve during dissection, this led Aristotle to think that this portion was a third ventricle of the heart; an error much more excusable, he says, than that of believing the number of ventricles to vary according to the bulk of the animal (*De humani corporis fabrica*,

1543, p. 590). Colombo takes the same view. Cesalpino, in defending Aristotle, boldly asserts that there are three ventricles in the heart not only of larger animals, but even of birds, as may easily be seen by making transverse horizontal sections of the heart, beginning with the base. We then see the middle or third ventricle separated from the left by a septum which reaches nearly to the apex. He admits that this is denied by the medical anatomists (*Quaestiones Peripateticae*, ed. 1593, lib. v. p. 118). Evidently he mistook the right flap of the mitral valve for a septum.

Harvey discusses the question in two places. In the MS. *Praelectiones* (fol. 74) he says he is astonished that Aristotle describes three ventricles so precisely: '*Nec posset salvari autor tam diligens et fidelis nisi auriculam sinistram pro ventriculo . . .*'; though Galen rightly blames him for making a difference between large and small animals. Hence he supposes that Aristotle took the left auricle for a ventricle. But in the *De Motu Cordis* (cap. xvii) he suggests that the position of the mitral valve perhaps misled Aristotle into thinking the left ventricle to be double ('*quae res imposuit forsitan Aristoteli ut hunc ventriculum duplicem sectione per transversum facta existimaret*'). Probably he was acquainted with the fallacy of Cesalpino, and

ventricle of the heart always wanting in animals which had no lungs and did not breathe air, like fishes (but not in all aquatic animals), and concluded that the right ventricle was made for the sake of the lungs¹.

thought Aristotle might have been misled in the same way.

The views of later commentators are discussed by Dr. William Ogle in his translation of Aristotle *On the Parts of Animals* (Notes, p. 197).

Some have supposed that the left auricle was not regarded, being empty and inconspicuous after death (an explanation, I think, adopted by Professor Huxley). Dr. Ogle thinks the three cavities were the right ventricle, the left ventricle, and the left auricle; and has minutely explained how this is possible. The great difficulty is that Aristotle makes all the cavities communicate with the lung, and does not speak of their communicating with each other. The left ventricle, on its aortic side, can only be regarded as communicating with the lung if the ductus arteriosus of the foetus be regarded as pervious, and this applies to Vesalius's explanation as well as Dr. Ogle's. The question is extremely obscure and perhaps cannot be explained. I confess I lean to the older explanation that Aristotle supposed the left ventricle to be divided; since I cannot believe that he used the word 'cavity' (*κοιλία*) in a different sense to that of all other ancient writers, or that he could have been so completely misunderstood by his followers as well as by his opponents, all of whom took that word to mean *ventricles* only. Aristotle was never blamed or excused for saying that the heart contained less than four cavities, but only for saying that it had more than two. His supposition that large animals had more cavities of

the heart than small animals is still more difficult to understand.

¹ Harvey maintains (MS. *Praelectiones*, fol. 74) that Galen was wrong on this point, and that fishes, having no lungs, want the *left* ventricle, not the *right*; that is, their single ventricle represents the *right* one of higher animals. (In the *De Motu Cordis* he speaks of the same subject, but his meaning is not so clear.) To ascertain the teaching of modern anatomists and zoologists on this point, I applied to my friend, Professor Ray Lankester, who has favoured me with the following note:—'As to the ventricle of Fishes, both Galen and Harvey are wrong. There is a third view, which is correct, viz. that the fish's ventricle represents *both* the right and the left ventricles. It becomes divided [in higher animals] by a septum which can be seen gradually becoming perfect. The septum first of all divides the great arterial trunk into two passages (functional in the Frog), then grows *into* or rather *from* the wall of the ventricle. In most Reptiles it is incomplete, but in Crocodiles is fully formed, so that the ventricle is strictly divided into two. The two auricles, on the other hand, are of independent origin, not formed by division of the original one. *That* remains as the systemic right auricle. The pulmonary is a new thing, developed on the pulmonary vein.'

Both Galen and Harvey were wrong!—but both were partially right: an excellent illustration of the two sides of the shield.

It appears, then, that Galen's sources of evidence respecting the motion of the heart were the same as Harvey's—viz. comparison of structure in a variety of animals, argument from the use of these structures, observation of the living heart, and numerous experiments on animals.

It may be asked, Why, if Galen had a correct method and knew most of the facts so accurately, did he not discover the circulation? The difference of structure between human anatomy and that of the inferior animals, which was Galen's weak point, did not come in here. But why did not Vesalius, or Fabricius, or Colombo, whose anatomical knowledge was quite as complete as was required, get near it? The fact seems to be that the problem was one of those in which you must be wholly right or wholly wrong. It is like those word-puzzles in which a number of letters are thrown on the table to make a word. No combination except the right one is much nearer the truth than another. The word is not spelt till the right combination is effected. So in this problem the mere accumulation of correct data was of little avail. Galen made a marvellously ingenious combination of letters, but it did not spell the right word. Harvey had no difficulty in showing that Galen was inconsistent with himself—more inconsistent, indeed, than those who knew less. Servetus and Colombo, who knew the lesser circulation, and Fabricius, who described the valves of the veins, equally failed, and were still more inconsistent¹. At last

¹ It is remarkable that in the edition of Fabricius's tract on the valves of the veins, published at Frankfort, 1624, we find a figure of the veins of the arm as tied up for bleeding, showing the situation of the valves, which was afterwards adapted by Harvey to make the well-known diagrams in his book *De Motu Cordis*, showing the use of the valves. Harvey's engraver must have been directed to copy Fabricius's plate (which is thus necessarily reversed)

on a reduced scale. Harvey's Figure 1, accordingly, is a reduced copy of Fabricius's plate, while in Figures 2, 3, and 4 the hands are added to show the experiments described in the text. As both works were printed at Frankfort within a few years, very likely the plates were executed by the same engraver, especially as the character of the lines and cross-hatching is identical.

It is very singular that Fabricius, having so carefully studied the valves

came the master mind of Harvey, which arranged the letters in the right order, and so the word was spelt for all the world to read. To do this required that peculiar high faculty of synthesis which is rightly regarded as an attribute of genius, and is closely allied to the poetical imagination. This faculty seems not always to follow the strict chain of reasoning, link after link, or to result from a mere collecting and marshalling of the data, however skilful, as Bacon supposed. The creation of the poet is generated in his mind from pre-existing sensations and ideas by a process which he cannot understand himself, and which the great poets have spoken of reverently as a kind of inspiration. So the idea of a great discoverer or inventor is generated by some process of which he himself may be only partly conscious; and a new form, like that idea of Harvey's of a *circular motion*, results. The difference is that the scientific idea, unlike the poetical, requires to be carefully verified and proved—a process which Harvey himself was the last to neglect.

Further to illustrate Galen's scientific method, I should like to say something about his physiology of the nervous system, to which justice has hardly been done, but which was certainly his greatest achievement. My object now is merely to show that Galen's method in investigating this subject was the only true one of observation and experiment, not to dwell upon his results, though they were very considerable. Before entering on this subject I should like to say a word on one point in which a difference of language makes Galen's views seem much more different from modern physiology than they really were—the old and famous doctrine of the animal spirits. He explained nervous action, both motion and sensation, by something

of the veins, and having had this figure executed to show the effect on the valves of ligaturing the veins on the cardiac side, should not have the slightest inkling of their real use. He thought them designed to prevent excessive dilatation or too

rapid a current in the veins, especially in the direction of gravitation. The valves at the commencement of the jugular veins, he thought, would only come into operation when the animal or man bent the head downwards.

descending from the brain through the nerves to the muscles and other parts. This something he called ψυχικὸν πνεῦμα, a phrase of which the modern translation through two languages into 'animal spirits' is somewhat misleading, being the origin of all our colloquial phrases about high and low spirits, and so on. The original meaning is rather 'breath of the soul,' or breath belonging to the 'psyche.' The word 'psyche' itself is difficult to render; soul, mind, consciousness, the sensorium, &c., all have other connotations, and so I find that some modern psychologists prefer to use the old term 'psyche' for that which we suppose to be manifested through the brain. I cannot suggest any better definition of the 'psyche' than the tautological one that it is the subject of the science of psychology. The 'pneuma' was supposed to be some kind of air or very subtle fluid capable of traversing the solid nerves. Our modern expression for what traverses the nerves is 'nerve force.' But I am not sure that 'nerve force' is a much more scientific expression, since the correlation of this force with physical forces is by no means rigidly established. It seems to be a convenient expression for something the nature of which we do not know; though in this I may be perhaps a little heretical.

However, in justice to Galen's ignorance we should remember that it was only the other day we were taught in every text-book of physics that electricity and magnetism were subtle fluids, and we were sometimes given the choice between the single fluid and the double fluid hypothesis. 'Electric fluid' is a vernacular phrase. The term 'nervous fluid' was retained in text-books of physiology which some of us learned from, and between nervous fluid and nervous pneuma there seems little to choose. The hypotheses of electric, magnetic, and nervous fluids no doubt explained many phenomena fairly well, till it was found there were other phenomena which they did not explain, and so they were given up. Galen unfortunately materialized his *pneuma* too much, supposing it to be included, like air, in the ventricles of the brain.

He also had strange theories of the production of swelling and tension by the pneuma, which, of course, were totally erroneous¹, and hence his theory seems more remote from modern science than it really is. But it might be shown, if I had time, how curiously he thought the presence of pneuma in the cerebral ventricles was proved by his numerous and careful experiments on the living brain. His method of investigation was in intention perfectly sound.

It is strange, too, that Galen was by no means absolutely wedded to the theory of a pneuma passing through the nerves. He says he has never been able to make up his mind whether the pneuma itself passes down into the nerves, or whether some kind of messenger descends from the brain so as to alter the constitution of the nerves, and this alteration is propagated to the parts which are moved. Again, some think, he says, that the action of the brain takes place by force (*δύναμις*) without matter, so that there is a flowing down of force from the brain; in fact, the modern view. This distribution of force he supposes to be equivalent to the communication of an altered state, which seems to be the most modern view of all, that nervous action consists in a transmission of molecular change through the nerve. This he illustrates by a fine and suggestive comparison with the radiation of the sun, which passes through the air and alters it, though the sun remains in its own place. Between all these views, he says, we cannot decide offhand².

The above extracts show how much a difference of language hinders us from understanding the thoughts of ancient writers; and also, I think, demonstrates the essentially scientific basis of Galen's mind, often concealed by his excessive subtlety and ingenuity.

Galen maintained the doctrine of the Hippocratic school, if not of Hippocrates himself, and of Plato, that the brain

¹ To find still stranger performances ascribed to the 'spirits' we have only to look at the works of

Willis, *On the Brain*, &c.

² *De Placitis*, lib. vii. cap. 4; Kühn, v. pp. 611, 617.

was the centre of voluntary movement, sensation, and thought (the same conception is perhaps indicated by the old Greek myth of Pallas Athene springing from the head of Zeus), though inconsistently he retained the old attribution of certain passions to other organs, such as anger to the heart. He showed that all the nerves originated in the brain, either directly or by means of the spinal cord, which he thought to be a conducting organ merely, not a centre. In opposition to this, it should be remembered, was the theory of Aristotle, who held that the heart was the seat of the sensitive soul with its correlative voluntary movement, and that what we should call nervous action originated there, while the brain was of secondary importance, being the coldest part of the body, devoid of blood, and having for its chief or only function to cool the heart. Aristotle's reasons for adopting this unfortunate misconception of the brain have been much discussed, and are fully stated in Dr. William Ogle's admirable translation of Aristotle *De Partibus Animalium*. They were partly positive observations, such as that the brain substance was itself insensitive, and that many animals which could feel and move (our invertebrata) had no brain, and that he could not trace any connexion between the organs of special sense and the brain. But also he was strongly influenced by his metaphysical idea that the 'sensitive soul' was indissolubly connected with heat, and therefore could not have its seat in the coldest organ of the body, devoid of blood. One wonders whether, if Aristotle had been a practising medical man or army surgeon, accustomed to study the effects of blows on the head, he would ever have propounded this theory¹.

¹ Aristotle's reasons for rejecting the older doctrine that the brain was the seat of 'the sensitive soul' are thus stated by Dr. W. Ogle (*On the Parts of Animals*, Notes, p. 172): (1) The brain is itself insensitive. (2) Many animals (viz. our invertebrata) have no brain and yet have

sensation. (3) The brain was, as he thought, bloodless. (4) He could trace no anatomical connexion between the brain and the organs of sense. (5) He believed he had good grounds for considering the heart to be the sensory centre.

I think there should be added

Aristotle's positive arguments for the heart being the centre of sensation and voluntary motion were partly the preconceived idea which I have just mentioned—partly his observations as a psychologist on the connexion of emotions with the heart, and also one fallacious anatomical observation. Seeing the chordae tendineae of the heart, he thought they were nerves and the source of all the nerves in the body. True, he did not distinguish between sinews and nerves, calling them all *νεῦρα* (*neura*), but he must have regarded these structures as having what we now call motor nervous functions, since he thought them the origin of

Aristotle's belief that the brain was cold, indeed the coldest part of the body, which alone, according to his psychological theories, would make it impossible for the brain to be the seat of the sensory soul. The brain was, he thought, compounded of earth and water, the other elements, air and fire, not entering into its composition.

Aristotle regarded the heart as the seat of sensation and voluntary movement, partly from *a priori* conceptions of the necessary connexion of the sensory soul with heat, and of heat with the blood, so that it must be located in the hottest part of the body; partly from tracing the connexion of emotions with the heart, and partly from some anatomical fallacies alluded to above.

The first argument seems clearly established by the following passage from the *De Partibus*, which I quote from Dr. W. Ogle's translation, p. 72:—

'The reason, then, why these two vessels [the vena cava and the aorta] coalesce into one centre and spring from one source is that the sensory soul is in all animals actually one; . . . and this oneness of the sensory soul determines a corresponding oneness of the part in which it primarily abides. Where, however, the sensory soul is lodged, there also, and in

the selfsame place, must necessarily be the source of heat, and, again, where this is there also must be the source of the blood, seeing that it thence derives its warmth and fluidity. Thus, then, in the oneness of the part in which is lodged the prime source of sensation and of heat is involved the oneness of the source in which the blood originates; and this again explains why the blood-vessels have one common starting-point.'

It is curious how long Aristotle's idea that the brain was cold met with acceptance. Galen, indeed, contends that the only test of anything being hot or cold is that it is so to the touch (a criterion repudiated by the Aristotelians), and he states that the brain is rather moist than cold, hotter than some and colder than other parts of the body; while the heart was found in vivisections to be by far the hottest part (*De Temperamentis*, lib. ii.). Piccolomini, an anatomist of the sixteenth century, quoted by Harvey, placed one hand on the heart, the other on the brain, in a recently killed animal, and found them equally hot (*Anatomicae Praelectiones*, 1586, p. 275). But we find Harvey, in his MS. *Praelectiones* of 1616, still teaching that the brain is cold.

all voluntary movements throughout the body ; though he does not appear to connect them with sensation. At all events, this was the foundation of the celebrated doctrine of the origin of nerves in the heart which was maintained by the followers of Aristotle for hundreds of years. Now one does not recall these misconceptions with the paltry aim, which I have already condemned, of branding as mere errors the imperfect generalizations of the great founder of natural science. It is on account of their historical importance. This point of the relation of the brain and heart was fundamental, and had, I think, a most injurious influence on the progress of physiology. Aristotle's great services to biology were, first, that he started the investigation ; then his great generalization of the unity of the animal kingdom, better appreciated now than ever ; and also his marvellous contributions to morphology, which seem to me incomparably more important than his explanations of function, which are largely tinged with metaphysics. In physiology his great achievement was his conception, derived from his studies of the embryo, of the indissoluble connexion of the heart, the blood-vessels, and the blood, by which he kept clear of the liver, that great stumbling-block of the medical anatomists. It was this which Harvey so much appreciated, and one reason which led him to speak of Aristotle with such generous enthusiasm.

Aristotle's great authority secured through many centuries the vitality of his views as to the rival claims of the heart and brain to be the seat of nervous function and the supreme organ of the body. They were supported chiefly by the philosophers, and opposed by nearly all the medical anatomists. They were the subject of active controversy in the time of Galen. In the Middle Ages they were maintained in opposition to Galen by Averroes, the reviver of the study of Aristotle ; and Cesalpino, often spoken of as a forerunner of Harvey, presented them again in the sixteenth century. Nay, about 2000 years after Aristotle's time, a professor at Padua contemporary with

Harvey, one Caesar Cremonini, wrote a long book to defend Aristotle's theories on these points in all their details against Galen and the modern anatomists¹. For all I know, they found still later defenders. Galen, as Harvey² says, in demonstrating the connexion of the nerves with the brain, might justly boast that he had discovered what was unknown to Aristotle, and thus, when he was endeavouring to found the physiology of the nervous system on the basis of experiment and observation, had to deal with Aristotle's views. Vesalius³ and others have blamed Galen for criticizing so severely the *obiter dicta* of the illustrious ancient philosopher. But it was impossible for Galen to look upon these matters with the dispassionate calm of an historian. It was a living question. He was meeting every day with people who said that the nerves originated in the heart, and that his ideas about the brain were mere fancies. He was thus inevitably drawn into an attitude of opposition. So in later times Vesalius and Harvey were forced to appear as the opponents of Galen, whom they greatly respected; for Galen in their time had warm supporters. But it should be remembered that, had Galen been out of the way, and had the tradition of physiology descended, as some seem to think it did, straight from Aristotle, Harvey must have appeared as the opponent of Aristotle himself. But Harvey's singleness of purpose and fine urbanity, it should be said, make him appear as little as possible the opponent of any one.

Our present question is, however, not whether Galen was right, but what were his grounds of belief? How did he meet his opponents? His great complaint against the Peripatetics or Aristotelians was that, while they discoursed about anatomy, they would not dissect. His way was to meet an argument with a dissection or an experiment.

¹ *Apologia dictorum Aristotelis de origine et principatu membrorum adversus Galenum Caesaris Cremonini in schola Patavina philosophi primae sedis*. Venetiis, 1627.

² MS. *Prelectiones*, fol. 95: 'Hoc iure gloriari Galenum invento Aristoteli ignoto.'

³ *De humani corporis fabrica*, 1543, p. 590.

'Come and see for yourselves' was his constant cry. 'A thousand times,' he says, 'I have demonstrated by dissection that the cords in the heart called nerves by Aristotle are not nerves and have no connexion with nerves.' Doubtless, in meeting the speculations of the philosophers, he often fell into the weakness of answering a fool according to his folly. At the special request of his friends, he says, he followed the philosophers into their own field and showed that he could spin out logic and quote poetry with the best of them. But I must try and give some idea of the strange intellectual atmosphere in which Galen upheld so manfully the standard of scientific truth. The followers of Chrysippus, a Stoic philosopher, are, says Galen, not ashamed to assert that when we wish to indicate emphatically 'I myself' we lay the hand upon the heart or nod the head downwards, pointing to the chest, whence it follows that the heart is the principal seat of the soul¹. But, says Galen sarcastically, some persons with the same intention lay their hand upon the forehead or the nose, which parts might as well be the seat of the soul—and so on. Chrysippus himself, whose words are quoted, had a still more extraordinary argument. He said that, when we utter the word ἐγώ to indicate our own personality, in pronouncing the first syllable e (ay) we protrude the lower lip downwards, pointing to the heart as the seat of our personality, and this is immediately followed by the last syllable; whereas in the word ἐκεῖνος (he) another syllable is interposed, and so apparently the significance of the first syllable is lost! Of this portentous nonsense it is very mild of Galen to say that it is not even a probable or a rhetorical or a sophistical argument, much less a scientific one².

The Stoics, according to Galen, were more difficult to deal with than the Peripatetics, because the latter, though they would not dissect, did know how to reason; but the Stoics were perfectly ignorant of the right method of

¹ *De Placitis*, lib. ii. cap. 2; Kühn, v. p. 216.

² *Ibid.*; Kühn, v. p. 215.

reasoning in science, though abundantly trained in logical speculation about useless things.

Galen here gives an interesting statement of his own views of the right kind of reasoning in science, for he recognized that observations and experiments always require the connecting link of reasoning to give them their true value, and that practice is necessary in the use of arguments, as it is necessary in calculation, to obtain a correct result. There are, he says¹, adopting the classification of Aristotle, four kinds of arguments. The best are the Scientific arguments, which relate to the substance of the thing. These are explained in the *Posterior Analytics*, a work of Aristotle which has been called the Logic of Science, and to which Bacon, in spite of his rejection of Aristotle, was probably much indebted. Next in value come those arguments called Dialectical, Gymnastic, or Topical, i.e. reasonings about matters probable, but not certain; and these are most akin to the first class. Then there are Rhetorical and Sophistical arguments, which are bad in proportion as they depart from the scientific kind; the latter most of all. They are exemplified in the *Elenchi Sophistici* of Aristotle.

His conclusion is that arguments from the opinion of men, whether of the vulgar, or of poets, or of philosophers, arguments from nodding or not nodding your head, arguments from words, are all bad arguments, most nearly allied to the sophistical kind. It is a bad argument to say that the heart must be the supreme organ of the body because it is in the centre; and equally bad to say that the head is the supreme organ because it is on the top². There are similar passages in his other writings which show that his standard of scientific reasoning was perfectly sound, judged by the criteria of Bacon or Mill.

¹ *De Placitis*, lib. ii. cap. 3; Kühn, v. p. 221.

² On the subject of scientific reasoning Galen had indeed written a work, *De Demonstratione*, now unfortunately lost. It should be ob-

served that he was a copious and important writer on logic, and is credited with the addition of a fourth figure of the syllogism. But only one short treatise of his on this subject has survived.

Another wild theory of the philosophers, founded apparently upon certain passages in Aristotle, was that the voice proceeded from the heart. Galen explains, as we should now, that voice is produced by an expulsion of air caused by the movements of the thoracic walls (which he clearly understood to be the cause of the movements of the lungs, and not vice versa) modified by the movements of the larynx, both organs being controlled by nerves coming from the brain¹. 'When I tell them this,' he says, 'and add that all voluntary movement is produced by muscles controlled by nerves coming from the brain, they call me *παραδοξολόγος*, "a teller of marvellous tales," and have no argument beyond the simple assertion that the trachea is near the heart. But what I say I can demonstrate by dissection.' Their method of simple assertion is much easier. 'They have chosen,' he exclaims, 'the short and easy way instead of the long and arduous way which alone leads to the desired end; but the short and easy way fails to attain the truth,' a phrase in which we seem to hear an echo of words better known to us about the broad and the narrow way. 'No one,' he goes on, 'has ever been able to withstand me when I have demonstrated the muscles of respiration and voice. The muscles move certain organs, but they themselves require, in order to be moved, certain nerves from the brain, and, if you intercept one of these with a ligature, immediately the muscle in which the nerve is inserted and the organ moved are rendered motionless.

¹ *De Usu Part.* vii. 5; Kühn, iii. 525. *De Placit.* ii. 4; Kühn, v. 233.

Galen in several places speaks of respiration being caused by the movements of the diaphragm and thoracic wall, which the lungs merely follow; and traces the connexion of these movements with certain nerves. Harvey in his MS. *Prelectiones* (fol. 84) states clearly and discusses this view, but does not assent to it. For various reasons he concludes that the lungs have a power of spontaneous movement and dilate

the chest: '*Puto potius cum Aristotele pulmones potius naturaliter pectus distendunt quam pectus ipsos*'; but admits that the diaphragm and chest assist or work in harmony. On this point Galen was clearly in advance of Harvey in 1616, and nearly agreed with modern views on the *mechanism* of respiration, except with regard to the functions of the intercostal muscles. Harvey promised a treatise on respiration, which never appeared.

Whoever is really a lover of truth, let him come to me, and if only his senses are unimpaired he shall see clearly in the animals themselves that free or normal inspiration is caused by certain organs, muscles, and nerves, and forced inspiration such as occurs in disease and in violent exercise, when we see the shoulder-blades raised, by other muscles; and so with expiration. Also I will show you the organ of voice, the larynx, its motor muscles and the nerves of those muscles coming from the brain; and similarly with the tongue, the organ of speech. I will prepare several animals, and show that sometimes one, sometimes another, of these activities is abolished when the several nerves are divided.'

Indeed, Galen wrote a special book on the dissection of the nerves in order to demonstrate their connexion with the brain. The opening words of this book show the relation of Galen's views on this subject to contemporary opinion. He says: 'It is admitted by all *physicians* that no part of the body has what we call voluntary movement or sensation without a nerve, so that, if the nerve be cut, the part immediately becomes motionless and insensitive. But that the brain is the origin of the nerves and likewise of the spinal marrow, and that the nerves arise, some from the brain, some from the spinal marrow, is not known to all; what appears on dissection, however, is as follows.'

The *philosophers*, it should be observed, did not admit even the first part of this statement¹.

If there were time it might be shown that his method in the investigation of the brain was the same. He was, indeed, a little impatient with the doctrine of Aristotle on this subject, and it is no wonder that he was so. When met by the Peripatetics with the assertion that the magnificent human brain served no better purpose than to cool the heart, why then, asks Galen, have we this complex structure, these membranes, blood-vessels, cavities, glands, nerves, when for the purpose of cooling only it ought to have been

¹ *De Nervorum Dissectione*, Kühn, ii, 831.

made like a kind of sponge, inert and shapeless¹? Other obvious arguments occur, but Galen's demonstration of the functions of the brain rested on the experiments he made on living animals. He found that serious injuries to the brain immediately abolished sensation and movement, and was aware of the law that injury to one side of the brain affects the opposite side of the body. He traced the effect of cerebral lesions on the voice and on respiration as well. But if the heart, he says, was injured in the same way none of these things happened; indeed sensation, voluntary movement, and the voice were set in violent activity, as we may well imagine, in the animals experimented upon². His actual conclusions I need not dwell upon, though it is clear that his conception of the brain and the nerves in relation to sensation and voluntary movement were essentially the modern ideas. It is evident from the nickname given him that his ideas were regarded as new and strange. Galen's experimental investigation of the spinal cord by sections at different levels and by half-sections was still more remarkable. It is quite modern in precision and completeness, but I cannot dwell upon it now³.

As regards his method, although it is now the fashion to praise Aristotle and not to praise Galen, it is clear that Galen's methods were far more scientific than those of his predecessor. Instead of dim adumbrations and analogies we have actual experimental proof. Galen was, in fact, a modern experimental physiologist, and may rightly be regarded as the founder of the physiology of the nervous system. Haeser, indeed, goes so far as to call him the founder of experimental physiology in general. It was long before he had any rival in this field. His own immediate successors seem to have dropped the experimental method, as, indeed, the whole idea of scientific investigation. On the revival of anatomy Vesalius and his contemporaries

¹ *De Usu Partium*, viii. cap. 3; Kühn, iii. 624.

² *De Placitis*, lib. i. cap. 6; Kühn, v. p. 185.

³ *De Administ. Anatom.*, viii. caps. 6, 9; Kühn, ii. pp. 683, 696. He refers also to the lost Book xiv.

practised vivisection, closely imitated from Galen, but established nothing in nerve physiology. Harvey published nothing about the nervous system. Willis reconstituted the anatomy of the brain, but added little experimental with regard to its functions. It is not till we come to the days of Sir Charles Bell and Magendie that we find any one comparable to Galen as a nerve physiologist.

Galen's application of his physiological knowledge in the diagnosis of disease is very striking. Here he makes it his first object to determine the organ or part affected by means of the functional disturbance. Thus he infers the height of a lesion in the spinal cord by noting whether the upper or lower limbs, the diaphragm, intercostal muscles, &c., are paralyzed, a method familiar to us, but unknown in the last century. In physiological diagnosis he stands alone among the ancients¹.

It is surely evident, then, that the conception of Galen as an ancient philosopher whose errors were exploded by Harvey is totally unjust. He was Harvey's most brilliant model and forerunner in one side of his work—the experimental—just as Aristotle was in another side—that of observation and generalization.

We cannot, I think, look without sympathy upon the spectacle of Galen wrestling with the philosophers, striving to bring them to the evidence of fact and the teaching of nature. There are many other references in his writings to the same combat of experiment and observation, on the one hand, against theory and tradition on the other. But it does not seem that his efforts were of much avail.

¹ Galen's most important observations of this kind are contained in his remarkable work *De Locis Affectis*, in which his guiding principle is that the task of the physician is to discover what part of the body is affected in disease, and to do this by a careful study of the *functional* disturbances present. Considering that morbid anatomy proper was at that time quite unknown, and its

study was indeed impossible, his results are often marvellously accurate. Sir William Broadbent in his Address on Medicine, 1895 (*British Medical Journal*, 1895, ii. p. 267), has quoted an admirable instance. The same eminent physician in his work on *The Pulse* (1890) has done justice to Galen's observations on this subject.

Philosophy went its way independently of him. The Peripatetics never learned to dissect, nor the Stoics to use scientific arguments. What was worse, the theoretical and traditional method infected Medicine itself. For a thousand years after Galen's death there were well-educated and learned Greek physicians, some of them acquainted with anatomy, in the Western and more especially in the Eastern empire. Practical medicine possibly advanced, as practical surgery certainly did, but scientific progress there was none. All was copying and compiling from the ancients, from Galen most of all; though he never enjoyed among the Greeks that position of absolute predominance which was his lot among the Arabs and in mediaeval Europe.

To inquire into the causes of this decay of originality and progress in medicine would be a question which I feel incompetent to discuss. All assigned causes seem to me somewhat inadequate, beyond the trite remark that the Greek genius seemed in some way exhausted. We know only that there are in the history of thought germinal epochs when new thoughts and new discoveries arise, often followed by long tracts of time in which men are capable only of repeating and copying, not of originating; just as in a plant there are nodes where alone buds, leaves, and flowers are put forth, and then internodal spaces with none of these. The botanist cannot explain the one, nor can the historian the other. But in regard to medicine I cannot see that this barrenness and the long reign of dogma were, as sometimes supposed, the fault of Galen's system. Other writers have shared the same faults, but by no means the same fate. It has not been their lot to reign supreme over the medical world for so many centuries. The fault was, as I said before, in the time; it was the subservient spirit of the Arabians and the mediaeval Europeans, and not his own demerit, that raised Galen to that bad eminence. It was the same with Aristotle, who, through no fault of his own, became, in another field, the intellectual monarch of the Middle Ages. In the case of both these great, though of course unequally great, men the excessive adoration

paid to them was succeeded by unjust neglect. They deserved neither the one nor the other. For Aristotle the reaction has come, and though no longer adored he receives due honour. For Galen I think the day of restitution cannot be long delayed. He was not one of the great geniuses of the world, but very high in the second rank. He was one of the most illustrious of all physiologists, and among the ancient physicians we may still allow him the old honourable epithet so often used, '*Omnium medicorum secundum Hippocratem facile princeps.*'

For our great Harvey we need not fear that his noble shade would be troubled at this tribute paid to his brilliant predecessor. His mind was too generous, and, indeed, it increases his praise, for to have succeeded where other acute intellects failed is the greater honour. Harvey himself warmly acknowledged what he owed to Aristotle, and if he mentioned Galen less it was because the force of circumstances made him his opponent. But at this distance of time we can see plainly that it was hardly necessary to mention him, for in so many places his work is taken for granted.

As I remarked in the beginning, all great work is based on work done before, even where the results appear to be different. And so we arrive, I venture to suggest, at the generalization that all high thought is really continuous. The magic of literature brings together thinkers widely separated in space and time, and, as one magnet makes other magnets, so the activity of one great mind sets other minds in vibration. The polarity of the second magnet may be opposite to that of the first, and so the result of the induced intellectual activity may be contradictory to that which set it in motion; but the one was nevertheless derived from the other. The moral is, I think, that the influence of the past on the present is even more potent than we commonly suppose. In common and trivial things we may ignore this connexion; in what is of enduring worth we cannot. As Goethe says,

In dem Vergangnen lebt das Tüchtige,
Verewigt sich in schöner That¹.

Hence the Past is worth our study, and ever more so the further we advance. This is, indeed, a growing sentiment. Even, or rather more especially, in this age of restless innovation and bewildering scientific progress the study of the past, whether of nature or of society, in geology, archaeology, or history (all embraced under the one head of evolution), is gaining a firmer hold on men's interests, and, inspired by better methods, has acquired wider scope and vision. With the revival of history in a wide sense there is evident a renewed interest in the *History of Medicine*, a study in which our own country, it must be confessed, has done perhaps less than any other of the greater civilized states. As a small contribution to this history I have endeavoured to bring before you, however imperfectly, this sketch of the relations of Harvey to his predecessors.

¹ All that has worth lives in the Past,
Enduring for ever in splendid activity.

APPENDIX



The references to Galen's works given above are made to the only edition available to modern students, that of Kühn, in Greek and Latin (Leipzig, 1821-33). Some of his more important works were translated into French by Daremberg (2 vols. Paris, 1854-6). A third volume, containing an Introduction and Dissertations, was to have been published, but has never appeared. There are no English translations worth mentioning, but the following sources of information may be consulted :—

Dr. W. A. Greenhill's article on Galen in Smith's *Dictionary of Greek and Roman Biography and Mythology*, which has been the foundation of some later works.—Dr. J. Kidd's Analysis of the Works of Galen on Anatomy and Physiology in the *Transactions of the Provincial Medical and Surgical Association*, vol. vi. 1837, p. 299.—Dr. R. Gasquet: 'The Practical Medicine of Claudius Galenus and his Time,' *British and Foreign Medico-Chirurgical Review*, vol. xl. 1867.—I would draw particular attention to Dr. James Finlayson's admirable account of Galen, with copious extracts, in his 'Bibliographical Demonstrations,' the first of which was published in the *British Medical Journal*, 1892, i. p. 573, &c. It is reprinted with a second lecture as *Galen: Two Bibliographical Demonstrations*, Glasgow, 1895. The second of these publications was not before me when I wrote this oration.—A good account of Galen's doctrines on the nervous system is given in *Galen's Lehre vom gesunden und kranken Nervensysteme*, by Dr. Friedreich Falk (Leipzig, 1871).—The above-named writers make, however, little reference to the work from which I have chiefly quoted, *De Placitis Hippocratis et Platonis*, which is rich in personal details as well as in physiological statements. A full account of Galen's position in relation to modern physiology is still a desideratum.

The standard histories of Medicine treat, of course, largely of Galen. Sprengel's well-known *Geschichte der Arzneikunde* is perhaps the most copious on this theme, but is not altogether satisfactory. In the eighteenth century, it seems to me, the backward state of physiology made a correct appreciation of Galen's experimental work impossible. He is really more in sympathy with the anatomical and physiological medicine of the nineteenth century, which represents the ideal towards which he strove. Had Galen been able to make post-mortem examinations and known how to ascertain the condition of the organs during life by Physical Diagnosis, his immediate aspirations would have been satisfied.

Hence the account of Galen in Daremberg's *Histoire des Sciences Médicales*, vol. i. (Paris, 1870), is more instructive than earlier expositions, though blame is freely mingled with praise. There is an earlier dissertation by Daremberg, *Exposition des Connaissances de Galien sur l'anatomie, la physiologie et la pathologie du Système Nerveux* (Paris, 1841), which I have not been able to obtain,

