HARVEY IN SPACE AND TIME*

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Since Andrew Duncan delivered the first of the Edinburgh Harveian Orations in April, 1778, on the 200th anniversary of the birth of William Harvey, there have been many memorable orations on a great variety of subjects. Only about one-fifth of the orations deal directly with Harvey and his work, because the Laws of the Society, very wisely, impose no restriction upon the choice of a topic. Each orator is faced with a problem which becomes steadily more difficult each year.

Every aspect of Harvey's life and doctrine has been subjected to the most detailed scrutiny, not once but many times. Notwithstanding all this, the oft-repeated tale may still prove stimulating to a new generation of "neophytes," as well as refreshing to mature and seasoned Harveians. I have therefore decided to stick to Harvey, and to delineate him against a background of geography and history, space and time. Under the first heading, some account is given of Harvey's three Continental journeys, and, in the second place, an attempt is made to trace the history of his discovery of the circulation and to explain the long delay in its acceptance.

During the past year I have made various pilgrimages in pursuit of Harvey; to his birthplace at Folkestone; his school at Canterbury; Caius College, Cambridge; St. Bartholomew's Hospital; and the Royal College of Physicians of London (though Harvey would scarce recognize any of those scenes to-day); to Oxford, where in the last stages of the Civil War he continued his studies in embryology, using the eggs of a hen which his friend George Bathurst obligingly accommodated in his rooms; and, finally, to Harvey's last resting-place in the little village church of Hempstead in Essex, now perhaps better known as the birthplace of Dick Turpin, the highwayman, than as the burial-place of William Harvey.

How vastly the British scene of Harvey's labours has changed. Abroad, he seems more clearly to fit the picture, especially in Padua, where, though the city is sadly scarred by bombing, one may still see the anatomical theatre where Harvey followed the demonstrations of Fabricius; and the pulpit used by Galileo. Almost certainly Harvey attended the lectures of Galileo, who did for science what Harvey did for medicine, replacing vague argument by accurate measurement.

Let me give you a brief account of Harvey's three visits to the Continent, as the influence of foreign travel upon his lifework is not always fully recognized.

I suppose Scotland at that time (as occasionally to-day) was regarded by the English as a foreign land. Harvey was with the Court when his Royal employer, Charles I, was crowned at Holyrood in 1633, and he came north again in 1634 and 1641.

But those Scottish journeys were so well described by Sir Henry Wade in a recent Harveian Oration¹ that I shall concentrate on the Continental wanderings, so significant in the colourful life of William Harvey.

*Oration to the Harveian Society of Edinburgh, met in the Royal College of Physicians of Edinburgh on June 15, 1956.

¹ Wade, Henry, *Edinb. med. J.*, 1938, 45, 761.

Student Days at Padua

The wandering physician is a familiar figure in history. Hippocrates, Galen, Paracelsus, and others were never very long in one place. The founders of the Edinburgh Medical School drew their inspiration from Leyden; and Sir William Osler, himself a mobile professor, was wont to say that permanence of residence, good for the pocket, was bad for the brain.

Harvey was fully aware of the advantages of study abroad, and it was fortunate for him that after he had taken his degree at Cambridge his father was eager to send him to the Continent and could well afford to finance such a venture. The choice of Padua as his postgraduate school was probably influenced by the fact that John Caius had studied there. To Padua, then, at the age of 19, William Harvey went, taking his degree in 1602, and, as representative of the English "nation," leaving his "stemma" or coat of arms, which was discovered by Professor George Darwin in 1892, in the cloister surrounding the old quadrangle of the University.

Unfortunately Harvey kept no diary, or, if he did, it has long since disappeared. Accordingly, in order to reconstruct for ourselves the Padua of that day we must refer to the records of contemporary travellers.

Boorde, Lithgow, and Coryat

Half a century before Harvey, the agile and versatile Dr. Andrew Boorde (or Borde), he who wrote the first medical book in English to be printed in England, *The Breviarie of Health*, in 1547, had journeyed far and wide, and had written *The First Booke of the Introduction of Knowledge* (1542), which may be regarded as the first Continental guide-book, a lively and informative account which is still well worth reading.

Another early traveller, not a medical man, was the Lanark-born William Lithgow, "lugless Willie," whose ears had been cut off because of a youthful misdemeanour. His book entitled *Rare Adventures and Painful Peregrinations*, 1632,² was very widely read in its many editions, although his information is not always accurate or credible.

More interesting than either of those, and more close to the time of Harvey, was Tom Coryat, son of the Rector of Odcombe, in Somerset. His was one of the most fascinating books of travel, under the title *Coryat's Crudities, Hastily Gobbled up in Five Months' Travels*,³ etc., and dated 1603, the year after Harvey left Padua. Coryat's description of Padua is interesting, although of course he had no special interest in the medical school. Venice he regarded as the most beautiful of all cities, "The richest paragon and Queen of Christendom," he called it. From there he walked all the way home, about a thousand miles, in one pair of shoes, which he hung up in his father's church, and there they remained for over a century. The exploit is recorded in verses contributed by his friends to the preface of his book. One of them wrote of Coryat,

How he did go at least nine hundred mile
With one poore paire of shooes, saving alone-a
He onely once did sole them at Verona
So that it grew a question whether
The shooes or feete were of more lasting leather.

Coryat mentions the Bills of Health, which, as we shall see, caused Harvey so much annoyance, and he may have

² The full title is: "The Totall Discourse, of the Rare Adventures, and painefull Peregrinations of long nineteene Yeares Travayles, from Scotland to the most Famous Kingdomes in Europe, Asia, and Affrica."

³ "Coryat's Crudities, hastily gobbled up in five moneths travells in France, Savoy, Italy, Rhetia commonly called the Grisons country Helvetia *alias* Switzerland, some parts of high Germany and the Netherlands: Newly digested in the hungry aire of Odcombe in the County of Somerset, and now dispersed to the nourishment of the travelling Members of this Kingdome."

been the first to introduce into England forks and umbrellas.⁴ He wrote, "The Italians cannot endure to have their food touched with the fingers, and do always use a little fork, of iron or steel or sometimes if they are gentlemen, of silver. Many do carry things they call umbrellas that minister shelter against the scorching sun." But let us return to Harvey.

There can be no doubt that the years in Padua had a profound influence upon his career. His teacher, Fabricius of Aquapendente, was a worthy successor of Vesalius, Colombo, and Fallopius. The work of Fabricius on the valves of the veins may well have initiated in the mind of young Harvey that train of thought which led to so spectacular a discovery.⁵

During the twenty-five years or so following his return from Padua, Harvey was busily engaged in London, as physician to St. Bartholomew's Hospital (1609), and in private practice, as Physician to the King, and as Lumleian Lecturer to the College of Physicians (1615). His title, be it noted, was that of Professor of Anatomy and Surgery. This period culminated in the publication of his book in 1628.

The Second and Third Continental Journeys

Harvey's second Continental journey took place in 1630, when he was chosen to accompany a wealthy young nobleman, the Duke of Lennox, on a grand tour of France and Spain. It was hoped to include Italy, but the visit was cancelled on account of plague. Of this tour there exists only the scanty detail contained in a letter from Harvey to Lord Dorchester. He writes from Spain, in a letter which reveals his inquiring mind, "We could scarce see a dog, crow, kite or raven or any other bird or anything to anatomise; only some few miserable people the relics of war and plague where famine had made anatomies before I came."

A few years later, in 1636, Harvey had the good fortune to make his third Continental journey, and of this tour we have a clearer record, revealed in a number of letters which came to light in 1911: letters from Harvey to Basil Fielding, afterwards Earl of Denbigh, who was, at the time, English Ambassador at Venice.

After he performed the famous post-mortem examination of Thomas Parr, the old countryman aged, or said to be aged, 152 years, who was brought from Shropshire to London by the Earl of Arundel, Harvey was invited by the Earl to accompany him on a political mission to Vienna, ostensibly an embassy, but also an expedition to acquire art treasures for the King. Harvey, a patron of the arts, and an expert critic, readily assented.⁶ The party left England on April 7, 1636, sailing from Margate in the ship *Happy Entrance*, and landing in Holland. They proceeded up the Rhine, then up the River Main, "in a boat drawn by nine horses." It was a leisurely journey, and Harvey had plenty of time to make observations on strange trees and plants, and would often wander so far that the Ambassador was angry with him, as there was real danger from thieves and wild beasts. Coryat, who had travelled by the same route, records the prevalence of robbers, and advises all travellers to carry a stout stick. At length they reached Frankfurt on May 3, and then Nuremberg May 11 to 22, where Harvey demonstrated the circulation of the blood to the Professor of Anatomy, Caspar

Hoffmann, who had been his fellow-student at Padua, but who was among those who misunderstood the discovery, saying that it was "contrary to the wisdom of Nature." "I beg you to observe," Harvey had written, "and to see the thing with your own eyes." Nevertheless Hoffmann remained unconvinced, and asked such stupid questions that eventually Harvey laid down his knife and left the theatre.⁸

Harvey in Quarantine

The second misfortune of this tour was of an entirely different nature. On the return journey from Vienna, Harvey had left the main party at Augsburg with the intention of travelling to Italy. He went by way of Munich and Innsbruck, then over the Brenner Pass, and on to Treviso on August 3, where, he writes, "I have received a very unjust affront." It was alleged that he had passed through a plague-stricken area without having his Bill of Health or "sede," the all-important passport, duly countersigned and cleared. Harvey, detained for this reason, writes to Lord Fielding, who expects him at Venice, "I am fallen into the hands of a base and evil people, and while they delight to exercise their tyranny, I am to lie in the open fields for God knows how long, and I fear it will do hurt to my health."

As a result of this letter Harvey was offered a roof and a bed, but this he declined, as he said "such offers were unseasonable, like physick when a man was dead"; and his next letter, on August 16, to Lord Fielding is even more doleful. "Their manners and cruelty have been shameful and I now have a sciatica that maketh me lame. I have never longed for anything so much as to be gone from this base place." It is difficult to understand why Harvey, then aged 58, a medical man, and a person of importance, should have been singled out and virtually imprisoned in quarantine for about a month. England was not held in high esteem on the Continent at that time. Perhaps the delay explains why Harvey did not return to visit his old friends at Padua. Besides, the thirty-five years which had elapsed since his student days must have brought many changes, and it is often very depressing to revisit the old scenes of one's youth.⁹

Eventually set free, he did reach Venice, where his reception was very different, as the next letter, dated from Florence on September 7, states, "I can never forget your many favours and your kind entertainment at Venice." He was joined at Rome by his friend Dr. George Ent in October, and although we have little knowledge of the homeward journey, we are told that Harvey visited the School of Anatomy at Leyden, that he had a rough crossing from Rotterdam, and that he landed at Deal on December 27, 1636.

Aubrey, who is at best a gossipy biographer, states that Harvey made a fourth journey to the Continent in 1649, but of this we have no certain knowledge.

The Slow Acceptance of Harvey's Discovery

Now let us turn to another aspect of Harvey's activity—namely, his work on the circulation of the blood, and the events which followed its publication. The foregoing references to Harvey as a traveller may be regarded as a fitting introduction to the adventures of his famous book and the curiously tardy acceptance of his great discovery.

⁴ "Coryat's Crudities": *A Continental Tour in 1608*, by Douglas Guthrie, *University of Edinburgh Journal*, Autumn, 1943.

⁵ The Hon. Robert Boyle had an interview with Harvey in later years, and was told that this was so. It is mentioned in one of the rarest of Boyle's works—*Disquisition about final causes of natural things*, 1688, p. 159.

⁶ The journey is described by William Crowne, a member of the expedition, in a little book of 70 pages which is now rather rare. It is entitled "A true relation of all the remarkable places and passages observed in the travels of the Rt. Hon. Thomas Lord Howard, Earl of Arundel and Surrey, Premier Earl and Earl Marshall of England, Ambassador Extraordinary, etc. (1637).

⁷ A more modern and extensive account is given in *The Life, Correspondence, and Collections of Thomas Howard, Earl of Arundel*, by Mary S. Hervey (1921), Ch. XXVI, pp. 357-395, which describes "The Great Embassy to Germany."

⁸ The most significant reference of recent date to this journey is the paper by Sir D'Arcy Power on "A Revised Chapter in the Life of Dr. William Harvey, 1636," in *Proceedings of the Royal Society of Medicine*, Sect. Hist., 1917, x, 33. Sir D'Arcy suggests that the demonstration of Hoffmann may have taken place on the homeward journey, when Nuremberg was again visited, from November 10-13.

⁹ *Eleven Letters of William Harvey to Lord Fielding, June 9-Nov. 15, 1636*. Purchased from the Earl of Denbigh and presented to the Royal College of Physicians by Sir Thomas Barlow, Bt., President: October 18, 1912.

Comments upon the letters are given in a chronicle of the family of Lord Fielding called "Royalist Father and Roundhead Son, being the memoirs of the first and second Earls of Denbigh, 1600-1675," by Cecilia, Countess of Denbigh (1915). Chapter VI, pp. 111-121, deals with "The Tribulations of Doctor Harvey."

I do not propose to refer in detail to his second work, *De Generatione*, 1651, dealing with those researches which arose quite naturally as a sequel to his work on the circulation, which occupied many years and which was eventually published in 1651, at the urgent request of Harvey's friend Sir George Ent. This work advanced embryology as far as that science could have gone without the aid of the microscope. Harvey, who laid great stress upon comparative anatomy, tells us that he used "a magnifying glass" to study the prototype of the heart in insects, shrimps, and other creatures, but he was not familiar with the microscope. It was left to Malpighi in 1661, and to Leeuwenhoek in 1674, to supply proof of the existence of the capillaries which Harvey presumed to exist as "pores in the solid parts, permeable to the blood, connecting the arteries with the veins" (*De Motu*, Ch. XI).

Harvey's masterpiece, the *Anatomical Disquisition on the Motion of the Heart and Blood in Animals*, often called for short, *De Motu Cordis*,¹⁰ published at Frankfurt in 1628, was printed on poor paper and was full of printers' errors. As an example of book production it ranks very low, but as a clear, brief, and logical account of the author's researches it is beyond praise.

The first English translation appeared in 1653 and the first Dutch edition in 1650. Other translations were much later products—German 1878, French 1879, Russian 1927, Danish 1929, and Spanish 1936. I can find no translation into Italian—a strange yet significant fact.

You will recollect how Harvey begins his "Disquisition" with a concise review of the existing knowledge, although, as he tells us in the preface, he has no intention of making a large volume. "I teach anatomy," he writes, "not from books but from dissections: not from the positions of philosophers but from the fabric of nature." Then he proceeds to defend the three propositions of his thesis, and to develop and expound the argument which you all, as Harveians, know so well.

As we read this little classic, the most important medical book every written, we find the discovery so plainly set forth that we marvel why it was not immediately accepted. The philosopher Thomas Hobbes said that Harvey was one of the few pioneers who saw his discovery universally accepted during his lifetime; but this is hardly true. Indeed, the real significance of Harvey's work in the practice of medicine was not apparent for at least two centuries, and it took about fifty years before those best qualified to judge, the anatomists and scientists, appreciated its significance.

Delay in Publication

Why this long delay in the acceptance of a truth so obvious? For the first part of the delay the discoverer himself was responsible. Harvey had not rushed into print. Darwin waited 20 years, Jenner 18 years, and Lister 8 years before publishing their results. Their work was not fully appreciated for many more years. Lind's recommendations for the prevention of scurvy were ignored by the Royal Navy for 43 years.

Harvey, from the first, made no secret of his discovery. He lectured on the circulation, as Lumleian Professor to the College of Physicians, for 12 years before stating his views in print. Thus when the book did appear some of his pupils and friends were ready to accept the new teaching, but others regarded Harvey as a crank. As Aubrey remarks, "Twas believed by the vulgar that he was crack-brained and he fell mightily in his practice."

It is sometimes said that Harvey's discovery was a mere accident, that all the evidence was there, awaiting the genius who would grasp the opportunity of assembling the facts.¹¹ There could be no greater error. Since student days at

Padua, and perhaps even then, Harvey had been continuously at work building up his argument and confirming each step by observation and experiment. His novel methods of investigation, so revolutionary in his day, and so different from the bookish methods of his predecessors, were in themselves deterrents to the acceptance of his results. It cannot be too strongly stated that Harvey had not only discovered the circulation of the blood, he had proved the efficiency of the scientific method in medical research, a proof which was to be stated even more clearly by Claude Bernard more than two centuries later. The discovery of a principle is always more important than the discovery of a fact, as it leads to further advances. Ehrlich's discovery of chemotherapy outshone his introduction of salvarsan as the remedy for syphilis. Lister's use of the antiseptic method was much more outstanding than was his use of carbolic acid, because here was a new principle, not just a new remedy. That is one reason for the long delay in belief in the circulation of the blood.

Tenacity of the Old Idea

And there is this further point—not only did the new discovery arise from the application of new methods of research; it could be accepted only by those who were prepared to discard the old beliefs. Before the new idea could be approved it was necessary to disprove the old. And at that time the dead hand of Galen still lay heavy upon medical science, if indeed it could be called "science." Prior to Harvey's day it was known that the blood moved, but with an ebb-and-flow motion in the veins, like the tides of the sea. The heart was not regarded as a pump; it drew to itself the blood as it dilated; in other words, diastole, not systole, was the important movement. The liver, not the heart, was the central organ concerned in the production and movement of the blood. It was thought that there were two kinds of blood—the dark variety, which originated in the liver and carried nourishment to the body, and the brighter-coloured blood, which came from the heart and supplied heat. The blood conveyed three kinds of spirit—natural, animal, and vital. The ideas were all very obscure and very hypothetical. It is to the credit of Servetus, the only real predecessor of Harvey, that he discovered that natural spirit and animal spirit were one, and that they became transformed into vital spirit in passing through the lungs.

Harvey himself stated that the cause of the change of colour was that the blood was "strained" as it passed through the lungs, just as earlier anatomists thought that the blood was strained, and thus altered in some way, as it oozed through the pores between the right and left ventricle of the heart. The foetal circulation was also ill understood, and Botallo (of Paris) in 1565 had added to the confusion by describing as a normal appearance a persistent foramen ovale which he found in an adult body.¹² It is true that Vesalius had shown that the septum between the ventricles was not porous; but the new anatomy of Vesalius had not been entirely accepted, and ancient textbooks with the Galenic descriptions were still in use. Many contemporary anatomists—Alexander Read at Barber Surgeons' Hall, Crooke and Collins at Cambridge, and Winston at Gresham College¹³—simply ignored Harvey's doctrine, and continued

¹² Castiglioni, A., *A History of Medicine* (Eng. trans.), New York, 1941, p. 428; Willins, F. A., and Dry, T. J., *A History of the Heart and Circulation*, Philadelphia, 1948, p. 45. (A pioneer in the anatomy of the foetus was Giulio Cesare Aranzio (1530-89) of Bologna.)

¹³ *The Reception of Harvey's Doctrine of the Circulation of the Blood in England as exhibited in the writings of two contemporaries*, by Sir Humphry Rolleston, in *Essays on the History of Medicine*, Sudhoff 70th Birthday Volume (1924). The two contemporaries are Winston and Power, and they illustrate the two extreme points of view. Thomas Winston, 1575-1655, repeats the description of pores in the septum which "cannot be seen in dead bodies because they fall together," but which serve to "strain" the blood. Henry Power, 1623-68, on the other hand, repeated and confirmed Harvey's experiments, and showed that "the partition wall is firm and compact, and absolutely devoid of any perforations."

¹⁰ *Exercitatio anatomica de motu cordis et sanguinis in animalibus*.

¹¹ The full story is admirably discussed in a series of papers by the late Dr. H. P. Bayon, entitled *William Harvey, physician and biologist: his precursors, opponents and successors*, in *Annals of Science*, 1938-9.

to teach along the well-worn lines, refusing to abandon the old ideas. Others were actively opposed to the new explanation, for various reasons, and often for very little reason at all.

For example, there were the clinicians, the so-called "practical" folk, who asked what was to be the use of this teaching. Did it really matter which way the blood moved? Had the so-called discovery saved any lives? According to the loquacious Dean, Gui Patin, of Paris, it was simply "an ingenious piece of fiction." This demand for a clinical outcome of his discovery was anticipated by Harvey when he wrote, "Many questions in medicine, physiology, pathology, and therapeutics can be answered by the truth we have declared, on which I might expatiate, but my whole life would not suffice for the completion of the work." More than once he refers to his "Medical Anatomy, or Anatomy in its application to Medicine." Perhaps this manuscript, like his notes on the Generation of Insects, was lost when the College library was destroyed by fire or when his rooms in Westminster were raided by a mob during the Civil War: "Rapacious hands stripped my house of its furniture, and, a subject of far greater regret to me, my enemies abstracted from my museum the fruits of many years of toil." Those were calamities which he greatly deplored.

Thus was the propagation of Harvey's doctrine delayed, a very different state of affairs from that which obtains to-day, when the discovery of a new antibiotic reaches the practitioner almost in advance of its time and with a speed which may even be dangerous.

Early Printed Criticisms

One of the earliest critics of Harvey to state his views in print was James Primerose (Primrosius), a physician of Hull who had studied under Riolan in Paris, and who evidently wrote for the sake of writing, upholding the older views in a work printed in 1630.¹⁴ He would probably have attracted little attention had he not been answered in a thesis at Leyden, *De circulatione*, by Roger Drake, a Cambridge student who upheld Harvey's views. Drake was supported by one of his teachers, Hendryk du Roy (Henricius Regius), of Utrecht, who entitled his work "A sponge to wash away the dirt of Primrosius,"¹⁵ which called forth from Primerose a reply headed, "An antidote to the poisonous sponge of Henricius."¹⁶ Both are dated 1640.

Another antagonist of Harvey was Emilio Parigiano (Parisianus), of Venice, who was answered with more dignity by Dr. George Ent, Harvey's lifelong friend, in his work, *An Apology for the Circulation of the Blood*, 1641. Harvey took no part in those controversies, well knowing that none of the critics had taken the trouble to really understand his views, and that they based all their arguments on the old conception. The only critic who received a detailed reply from Harvey (a reply printed in English editions of *De Motu Cordis*) was Jean Riolan, of Paris, who had been his fellow-student in Padua. When Riolan remained unconvinced Harvey wrote a second letter in rather stronger terms. The duel of words ended in 1690, when Pierre Dionis, a supporter of Harvey and a teacher of his doctrine, assumed the Chair of Anatomy in Paris.

The famous anatomist Thomas Bartholin, 1616-80, was the first to introduce the knowledge of the circulation into Denmark,¹⁷ but he did not do so wholeheartedly, as he described in his textbook, *Institutiones Anatomicae*, 1641, both the old and the new view, apparently leaving the reader to form his own judgment. Harvey's views are contained in a Supplement by Jan de Wale (Walaeus), of Leyden.

¹⁴ Flourens, P., *Histoire de la Découverte de la Circulation du Sang*, 1854.

¹⁵ Regius Henricius, *Spongia pro eluendis sordibus animadversionum J. Primrosii*, Leyden, 1640.

¹⁶ Primrosius, Jacobus, *Antidotum adversus spongium venatum Henrici Regii*, Leyden, 1640.

¹⁷ Gotfredsen, E., *The Reception of Harvey's Doctrine in Denmark*, *Acta med. scand.*, 1952, 142.

Spain was one of the last countries to accept the new knowledge. It has been said that Harvey's work was banned by the Inquisition, but I have been unable to discover the source of this statement. Even in the eighteenth century, Galenic anatomy was still taught in Spain, and Professor Izquierdo, who in 1936 undertook the first translation of *De Motu* into Spanish, tells us that while Sobremonte, in 1649, and Morello, in 1678, accepted and wrote upon the Harveian view, Piquer, of Valencia,¹⁸ as late as 1751, was antagonistic, and still taught the older idea. Izquierdo also states that the first book on physiology written and printed in the New World in 1727 was the *Cursus Medicus Mexicanus*, by Salgado, of Los Angeles.¹⁹ It gave "a confused idea of the circulation," and probably the author had never seen Harvey's treatise. Nevertheless, Salgado's work was still used as a textbook at the end of the eighteenth century.

Harvey's First Supporters

From those critics, most of them slaves of the age-long teaching, and sworn Galenists, it is a relief to turn to those who were ready to free themselves from the influence of Galen, and to accept the new view regarding the circulation, or at least to ascertain for themselves by experimental methods whether it could be true. Of those supporters, one of the first was Robert Fludd, a man four years younger than Harvey, who was a leader of the so-called Rosicrucians, and whose mystical works were printed in Frankfurt by William Fitzer, who also published Harvey's masterpiece.²⁰ In his *Integrum Morbium*, of 1631, Fludd makes a favourable reference to the discovery of the circulation.

René Descartes, in his *Discours de la Méthode*, 1637, accepted Harvey's principles, and so did Francis Glisson, whose classic work on the liver, *Anatomia Hepatis*, 1654, reinstated the liver in correct perspective. As early as 1639 the renowned Francis de la Boe (Franciscus Sylvius) was giving demonstrations of the circulation, in dogs, to his class at Leyden.

Werner Rolfinck, of Jena, was a well-known anatomist who in 1641 believed and taught that the blood circulated, while Nathaniel Highmore introduced the new discovery into his book on anatomy, dedicated to Harvey, which gives one of the earliest descriptions of the circulation.²¹

Sir Thomas Browne, whose view must have carried weight, said that he regarded Harvey's discovery as better than the discovery of America, and few to-day would disagree with that opinion.

Of course the most helpful of the critics were those who took the trouble to repeat Harvey's experiments rather than merely argue about them. Such a one was Hermann Corning, of Helmstadt, whose book, *De Sanguinis Circulatione*, 1643, brought strong support to the doctrine, as also did the work of Henry Power, one of the first to use the microscope, whose experiments are described in his *Microscopical Observations on the Lamprey*, 1664 (see footnote 13). This, surely, was the only true method of appraising Harvey's work, by repeating his experiments, by applying to his results the method which he himself used to secure them.²²

No reference to Harvey's discovery is complete without some mention of the controversy regarding priority which continues unabated to this day, especially, perhaps, in Italy. All manner of absurd claims have been made, often on very slender evidence: that the circulation was known to the ancients—to the early Chinese and to Hippocrates, to

¹⁸ Piquer, Don Andres, *Institutiones Medicae*, Madrid, 1751.

¹⁹ Izquierdo, J. J., *Harvey, iniciador del methodo Experimentale*, Mexico, 1936.

²⁰ Weil, E., "William Fitzer, the publisher of Harvey's *De motu cordis*"; *Library*, 1944, 24, 142.

²¹ Highmore, Nathaniel, *Corporis humani disquisitio anatomica in qua sanguinis circulationem . . . prosequitur est*, 1651.

²² There is an unpublished manuscript (Sloane MS., 1543) in the British Museum dated 1652 in which Henry Power describes experiments to demonstrate the circulation, performed by Harvey in 1614, two years before the usually accepted date of the discovery.

Arabian physicians and to a numerous band of anatomists, mainly of Italian birth, who lived shortly before the time of Harvey. The confusion of ideas was increased by frequent misinterpretation of the word "circulation," which at first simply denoted movement. Everyone who has driven a car in France must be familiar with the policeman swinging his baton and urging the traffic to move on. "Circulez, circulez," is his order.

Late Claims for Priority

It is sometimes forgotten that nothing was said of other claims to the discovery until Harvey's view was beginning to meet with general acceptance, about 1650. Not one of the earlier critics claimed that the circulation of the blood was already known, or had been discovered by someone else before Harvey.²³ The claim of Cesalpino was mentioned for the first time in 1655 by Nardi. There is a statue of Cesalpino in Rome, proclaiming him to be the discoverer of the circulation of the blood. This claim was followed by allegations that the discovery was made before the time of Harvey by Colombo, Ruini, Servetus, and others. It is true that Servetus had discovered the lesser circulation, as also had Colombo and the thirteenth-century Arab physician Ibn Nafis, whose work has come to light recently. But both Servetus and Colombo adhered to the pre-Vesalian anatomy: they believed that the blood was prepared in the liver, and then flowed through the heart to the veins.

The interest of Servetus in the blood stream arose from his desire to find a habitat for the soul. The physiological work of Servetus was first quoted by William Wotton in 1694²⁴; it had attracted no attention until then. The trend of Servetus was to theology rather to physiology, and it was on account of his Unitarian views that he suffered martyrdom in 1551. Edinburgh University, possessing one of the three surviving copies of his *Restitutio Christianismi*, has a peculiar interest in Servetus. Further discussion of those claims for priority of discovery, which continue to this day, would carry us far from the present theme—namely, the reasons for the long delay in the acceptance of the circulation of the blood.

Conclusions

An attempt has been made to explain this delay, which arose from a variety of causes. These may be summarized in conclusion as follows:

1. The so-called "practical" physicians of Harvey's time, who demanded that every new discovery should be immediately applicable as a life-saving or health-restoring measure, regarded the circulation of the blood as a matter of academic importance only.²⁵
2. The refusal to abandon the fixed age-long traditions, dating even from the days of Galen, prevented many from accepting, or even from studying for themselves, a conception so contrary to current opinion.
3. The new doctrine of the circulation involved not only a change of view regarding the motion of the heart and blood but also a revolutionary change in methods of investigation; a completely new outlook; the replacement of scholastic argument by direct observation and experiment. The change was so staggering that it could hope to gain acceptance only by slow degrees.

The delay in the acknowledgment of the circulation of the blood was a phenomenon peculiar to the age in which Harvey lived.

²³ Johannes Antonides Van der Linden, 1609–64, a famous Dutch physician, did all he could to discredit Harvey, and stated that it was George Heriot, 1563–1624, jeweller to James VI of Scotland, who first suggested to Harvey the idea of the circulation of the blood.

²⁴ Wotton, William, *Reflections upon Ancient and Modern Learning*, 1694.

²⁵ At first Harvey's doctrine exercised a more profound effect upon biology than upon medicine; it formed a starting-point for a vast number of further biological investigations.

Few were prepared to write, as Abraham Cowley did:

Thus Harvey sought for Truth in Truth's own book
The Creatures which by God himself was writ
And wisely thought 'twas fit
Not to read Comments only upon it
But on th' Original itself to look.

The experimental method of investigation, as novel to Harvey's critics, is now familiar to the most junior medical student. It has long since ceased to be a matter for argument. Moreover, increased facilities of transport and communication have made it possible for a new discovery to be known throughout the world in a matter of hours. Within a few weeks, or months at most, each addition to the existing knowledge is examined and assessed at its true value. Indeed, the speed of integration of new discoveries and new ideas has become almost terrifying. Thus, it is not only right and proper, but even salutary, for us to turn back the pages of history, to recall Harvey's experience, to assess his achievement, at this Festival when we are met to honour his memory.

Reports of Societies

HOW MANY HOSPITAL BEDS?

A FRESH APPROACH

The capital cost of providing one new hospital bed in Britain is now about £4,000. This fact was the background to two papers read to the Medical Section of the Royal Statistical Society at a meeting at Westminster Hospital on February 26. Dr. A. T. ELDER, deputy C.M.O., Ministry of Health and Local Government, Northern Ireland, described the use of "case-load" studies in estimating a community's need of beds. Mr. D. J. NEWELL, who is a lecturer in statistics at Durham University, dealt with the question of beds for emergency admissions, and was able to offer a novel solution to this knotty problem.

"Pooled Discharge Wards" and Emergency Beds

How many beds should a hospital keep for emergencies? What figure most nearly combined maximum preparedness with maximum economy? Mr. NEWELL had studied emergency admissions at a non-teaching hospital in the North-eastern Region. The number of such admissions, he said, followed a well-known statistical pattern, the "expected" level remaining remarkably constant on week-days throughout the year and only falling slightly on Sundays. Using this finding as a basis, he was able to show that each day a "unit" must set aside two more beds than the expected number of daily emergency admissions if it was to keep the chance of refusing a patient (or putting up an extra bed) below 5%. If, for example, a hospital had 10 units—and for this purpose male and female wards must be counted separately—each of which expected an average of two emergency admissions a day, then the hospital must set aside 40 beds every day. In these circumstances, on an average day about half the beds would be wasted. These calculations assumed that emergency admissions were not interchangeable between the units. But if all the emergency admissions, regardless of sex and specialty, went into a special ward set aside for the purpose, it would need only 22 beds to cope with the "expected" figure of 20 admissions a day—a daily saving of 18 beds.

Mr. Newell went on to point out the obvious disadvantages of such a "pooled admissions ward"—for example, the difficulty of providing special facilities and methods of nursing for all types of emergencies, and the dislocation involved in moving a patient at what was perhaps a critical stage in his treatment. In its place Mr. Newell suggested a