

News, Notes and Queries

THE ORIGINS OF BLOOD TRANSFUSION: A REASSESSMENT

THERE IS general agreement among historians about the pioneering phase in the history of blood transfusion. It is recognized that the first effective blood transfusions on animals were undertaken by Richard Lower, who demonstrated his experiment to distinguished scientists at Oxford in February 1666. Within the year the technical details were published in the *Philosophical Transactions* of the Royal Society, making the experiment accessible to virtuosi throughout Europe. The medical potentialities of transfusion were quickly recognized; the French physician, Jean Denis, being the first to perform a medical transfusion, apparently without ill effects, in 1667. Transfusion experiments became one of the most attractive novelties at the meetings of the fledgling scientific societies, giving grounds for considerable debate on the background to the innovation.

The pre-history of transfusion was quickly established. Lower himself was adamant that he was the first to reason out the experiment and carry it to a successful conclusion. He knew of no earlier speculations about transfusion, or attempts to perform the experiment before 1665.¹ During this year it is probable that he and members of the Royal Society independently began experiments on transfusion. However, the Royal Society obtained only inconsequential results until they were assisted by details of Lower's experiments. If transfusion had any significant ancestry, Lower argued that it was indebted to the technique of intravenous injection, which had originated at Oxford in 1656 and subsequently shared much of the appeal of transfusion.²

With minor reservations, modern commentators agree with Lower. The general therapeutic value of blood had certainly been the subject of comment for centuries. By the seventeenth century the idea of direct transfusion had evolved, the best known reference to this coming from the celebrated chemist, Andreas Libavius. But the evidence is diffuse and scattered, indicating little more than a passing curiosity about transfusion and injection.³ The only figure who is known to have attempted the

¹ Richard Lower, *Tractatus de Corde*, London, 1669. Since Walter Charleton replaced 1669 by 1668 in his copy (British Museum, C.113.6.7) the work was probably available in the early months of 1669, i.e. 1668 Old Style. Hence it was composed in 1668: see *Term Catalogue*, I, 10, 19 May 1669. In the quotation below, *ante triennium* indicates 1665. 'Nunc quod porro tradituri sumus, De ipsius transfusione ex hoc in aliud animal nescio ante triennium proxime elapsam, an cuiquam injecta sit aut perficiendi spes aut experiendi cogitatio . . . Itaque lubet mihi rem totam, ut gesta est, exponere, simulque ostendere, & qua ratiocinandi serie, a me primum excogitata atque suscepta, & quibus demum mediis & auxiliis ad effectum perducta sit.' pp. 171–2.

The author would like to acknowledge the valuable assistance of A. J. Turner in the preparation of this article. Mr. Turner is currently engaged in a detailed study of the Aubrey manuscripts and Oxford intellectual life of the later seventeenth century.

² The injection experiment was attributed to Wren; see Robert Boyle, *Usefulness of Experimental Natural Philosophy*, Oxford, 1663; *Works*, ed. T. Birch, 6 vols., 1772, vol. II, p. 88. For the date 1656, see a letter from Wren to Petty, 1656, in *Parentalia*, ed. C. Wren, London, 1750, p. 228; also T. Clark's letter, *Phil. Trans. R. Soc. Lond.*, no. 35, 18 May 1668, p. 678.

³ For a full discussion of the speculations about blood transfusion, see P. Scheel, *Die Transfusion des Blutes*, Copenhagen, 1802; H. Buess, 'Die Bluttransfusion', *Ciba Zeitschrift*, 1956, 79; *idem*, *Die Historischen Grundlagen der Intravenösen Injektion. Ein Beitrag zur Medizingeschichte des 17 Jahrhunderts*, Aarau, 1946.

experiment is Francis Potter, but his efforts are thought to have been a failure.⁴ However, there is more evidence about Potter than has been generally recognized, particularly in the manuscript collections of John Aubrey, preserved in the Bodleian Library, Oxford. On the basis of this evidence, it will be suggested that Potter's interest in transfusion was more serious than hitherto believed, his experiments embracing man as well as animals. His techniques improved and may ultimately have been successful. Finally, the possibility of connexions between Potter and the later experimenters will be considered.

John Aubrey, the celebrated intelligencer and virtuoso was not satisfied with contemporary estimates of Potter, whom he regarded as a neglected inventive genius. Potter's work was publicized in Aubrey's correspondence and the inventor was the subject of a prominent entry in the biographical notes which he was assembling for publication. However this material was only generally available through excerpts in Wood's *Athenae Oxonienses* and more extensively in the Victorian edition of the *Brief Lives*.⁵

When confronted with Plot's standard account of the origins of injection and transfusion at Oxford, Aubrey was prompted to add a marginal note: 'tis false. 'twas Mr. Fr. Potter B.D. author of ye Interpretation of ye No 666 as by his letter to me appears dated . . .'.⁶

Aubrey drew attention to two of the main grounds for Potter's contemporary celebrity, transfusion and the numerical interpretation of the apocalypse. This indicates a diversity of interests and preoccupation with theological goals which was not uncharacteristic in the seventeenth century. Francis Potter (1594–1678) was the younger son of Richard Potter, Rector of Kilmington, Somerset. After education at Trinity College, Oxford, he succeeded his father as rector of Kilmington. He remained there, unaffected by the turmoils of the civil wars, until his death. Aubrey described his life as that of a hermit, deeply absorbed with his inventions, which included dials, quadrants, a graduated compass, a perspectograph and water-raising engines. He was also a talented artist, his portrait of the founder of Trinity College being preserved. His biological works included the study of bees under a microscope and transfusion. However none of these enterprises was known through publication. His only book was the celebrated *An Interpretation of the Number 666* (Oxford, 1642) which went through a further English edition and was also translated into Latin. Potter's speculations about the numbers 12 and 25 as the keys to the interpretation of the apocalypse produced considerable debate. Joseph Mede, the distinguished biblical scholar, thought that this tract on the number of the beast, 'is the happiest that ever yet came into the world'.⁷

⁴ For representative judgements on Potter, see E. C. Hoff and P. M. Hoff, 'The life and times of Richard Lower', *Bull. Hist. Med.*, 1936, 4, 517–35, pp. 528–29. G. L. Keynes (ed.), *Blood Transfusion*, Bristol, 1949, p. 4. *idem*, *The Life of William Harvey*, Oxford, 1966, p. 313. Buess, *op. cit.*, 1946, p. xx. Keynes and Buess not only assert that Potter's experiments were unsuccessful, but also that they were made in 1662. This is presumably based on a misreading of the date 1652 in the letters discussed below.

⁵ A. Clark (ed.), *Brief Lives*, Oxford, 1898, 2 vols., vol. II, pp. 161–70. A. Wood, *Athenae Oxonienses* (ed. Bliss), 3, pp. 1155–57.

⁶ Robert Plot, *The Natural History of Oxfordshire*, Oxford, 1677. Bodleian Library, Ashm. 1722, p. 304. John Aubrey's copy.

⁷ Letter from Joseph Mede, Christ's College, Cambridge, to Samuel Hartlib, 29 January 1638; from *Works*, ed. J. Worthington, London, 1664, p. 1076. Hartlib had been circulating the *No. 666* in manuscript form.

I am, Sir, I am, Sir, that I can as yet give you no
 better account of that experiment of which you desire
 to hear. I am as yet frustrated in my limits, but it
 may be my own stupidity who never attempted any such
 thing, and may be any creature (before) for I cannot although I have
 made considerable quantities. I have prepared a little glass being
 now the present vessel (like into a bladder) made of such the
 - 105. Dr. G. ...
 one of the pipes neck of it, and I have put it into
 a joint of the hind leg, and yet I cannot about 2 or
 3 days of blood to come into the pipe or the bladder.
 I would have sent this bladder and pipe in my letter
 to you, but that it might be an occasion
 that my letter might not come into your hands.
 This is the rude figure of it, which I do not yet do
 because I think it the most convenient for this purpose

- a - the neck of the crass which goes to the mouth.
- b - the other neck which goes to the bladder.
- c - a little pipe as a bladder.
- e - the capacity of the crass bladder.



another pipe may be tied
 to this end, and put into
 the veins of another
 living creature at the
 same time.

I found that oyle in a little glass which you
 had from M^r Desart. and a receipt in another letter,
 and I

Plate 1. Letter from Francis Potter to John Aubrey, 5 December 1652.
 Bodleian Library, Oxford, Aubrey MS. 6, f.61r.

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John Aubrey (1626–1697), like Potter, was from the West Country and attended Trinity College, Oxford. There his gregarious habits were quickly established, his associations being recorded in notebooks containing fragments of information relating to celebrities and events of the times. An early object of his interest was William Harvey, whose visits to Trinity College to inspect the chicks incubated in George Bathurst's chambers, were recorded in his undergraduate notes. By 1651 he had become a firm friend of Harvey.⁸ The association with Francis Potter was possibly made through Hannibal Potter, D.D., his elder brother, who disapproved of scientific preoccupations. Hannibal Potter was a leading Fellow of Trinity College during Aubrey's student days.

Aubrey became one of the few close friends of the retiring Potter, paying visits to Kilmington from his home at Broad Chalke in Wiltshire. After a visit in 1649, he recorded: ' . . . he then told me his notion of curing diseases etc. by Transfusion of bloud out of one man into another, and that the hint came into his head reflecting on Ovid's story of Medea and Jason, and that this was a matter of ten years before that time.'⁹

Thus, Potter had originated the idea of transfusion in about 1639, probably ignorant of the similar speculation of Libavius. As indicated below, it is also possible that acceptance of circulation had played some part in stimulating belief in the effectiveness of transfusion.

Potter, assisted by his intimacy with mechanical innovations, was in an ideal position to advance beyond the speculations of earlier writers. His first apparatus was demonstrated to Aubrey in 1650, but without success.¹⁰ Aubrey felt that the use of a surgeon's lancet would improve results, but again there was very little success. Potter's letter giving an interesting account of his techniques is given in full below. Earlier estimates of Potter's work have tended to rely only on this evidence.

[Kilmanton, Dec. 7 1652]

Worthy Sir.

I am sorrie that I can as yet give you no better account of that experiment of which you desire to heare. I am as yet frustrated *in ipso limine* (but it is by my owne unexpertnes who never attempted any such thing upon any creature before) for I cannot although I have tried divers times, strike the veine so, as to make him bleed in any considerable quantity.

I have prepared a little cleare transparent vessel (like unto a bladder), made of the craw of a pullet, and I have fastened an ivory pipe to one of the neckes of it, and I have put it into a veine which is most conspicuous about the lowest joint of the hinder legges, and yet I cannot procure above 2 or 3 drops of blood to come into the pipe or the bladder.

I would have sent this bladder and pipe in my letter unto you, but that I feare it might be an occasion that my letter might not come into your hands. this is the rude figure of it which I do here set down because I thinke it the most convenient for this purpose:—

a=the necke of the craw which goeth to the mouth

b=the other necke which goeth from the craw to the gissar. Another pipe may be tied to this end and put into the veine of another living creature at the same time.

d=a little crooked ivory pipe, fastened (as a clister pipe is) to a bladder.

e=the capacity of the craw or bladder.¹¹

⁸ Keynes, *Life of William Harvey*, op. cit., pp. 381–85, 431–37.

⁹ Bodleian Library, Aubrey MS. 6, f. 63v. The celebrated classical myth is taken from Ovid's *Metamorphoses*, L, vii.

¹⁰ Aubrey MS. 6, f.63v.

¹¹ Aubrey MS. 6, f.61r. For the letter and diagram, see Plate I. The date and place are given in a postscript dealing with another subject. For a complete transcription of the letter, see A. Clark, *Brief Lives*, op. cit., vol. II, pp. 166–67. My reading of this letter differs only in minor points.

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This letter gives adequate proof of the seriousness of Potter's practical interest in transfusion, his technique being the result of work between 1650 and 1652. The apparatus embodied the main essentials necessary for success, lack of results being due to choice of material, the pullet being readily available, but anatomically unsatisfactory. In the later successful experiments at Oxford and the Royal Society, birds were generally avoided, although in May 1665, Thomas Cox claimed to have performed a transfusion between two pigeons.

In spite of the limited success of this experiment, Aubrey regarded the letter as sufficiently significant to merit the attention of the Royal Society as evidence against the priority claims made by Lower. He also considered allowing the provincial medical practitioner, Richard Griffith, to publish the letter in his book against plebotomy.¹²

This is generally thought to have been the end of Potter's interest in transfusion. However, one further letter is concerned with the experiment. This indicates interesting sophistications in technique and has previously been overlooked. It is given in full below.

Kilmington, Oct. 3 1653

Sir,

I have returned your 3 little bookes, some of them defaced with marginall notes as you desired. I will within a fortnight if I can have time, send you those marginall Notes on Sr. Kenelme Digbies book¹³ or els the booke it selfe, which you may returne at your leysure. As for the bellows for bloudletting they be no other then just such as those little bellows for a watch¹⁴ which I showed you, only they must have two little flexible pipes made of the windpipes of some small animals, one of which must goe into the vayne of one arme which is to receive bloud, and the other into the veine of another arme from whence it is to be taken, and as they are filled with bloud, that is, as those bellows are drawne open, your finger must be layd on one pipe that the bloud come not backe out of the veine, into which it should goe, and as those bellows are crushed downe your finger must be laid on the other pipe, that bloud goe not backe into the veine whence it came. Those 2 soft flexible pipes must have two little quilts of the same bignes fastned to ye ende of them, that they may enter in the veines. I rest, in hast remembering my humble service to you, and am, yours to be commanded.

Francis Potter¹⁵

In the ten months since the well-known letter to Aubrey, Potter had graduated to better experimental material and introduced a number of improvements to his technique. Most importantly, he recognized that transfusion between the veins of the human arm offered much greater chances of success than slender veins of domesticated fowls. In place of the soft stomach, a bellows was introduced into the apparatus, giving the opportunity to apply pressure from this auxiliary 'heart'. Like Lower, Potter used quills for the insertion into the veins. Although an actual transfusion experiment was not recorded, Potter shows himself familiar with the train of events

¹² Aubrey MS. 6, f.63v. Richard Griffith, *A-la-mode Phlebotomy*, London, 1681, p. 201. Griffith refers to the letter in a footnote but gives no indication of its contents.

¹³ Probably, Sir Kenelm Digby, *Two Treatises . . . The Nature of Bodies . . . the Nature of Mans Soule*, Paris, 1644. This contained extensive sections on physiology.

¹⁴ Potter was making extensive use of bellows at this time, for such purposes as driving mills, draining, and as a method for ventilating submarines. The above reference probably relates to attempt to design clocks without wheels. Designs for clocks involving bellows were introduced in the seventeenth century. Aubrey's friend, Robert Plot, described a bellows clock designed by John Jones of Jesus College, Oxford, *Natural History of Oxfordshire*, 1676-7, p. 230.

¹⁵ Aubrey MS. 13, f.147r.

involved, his technique being remarkably similar to that evolved by Aveling in the later nineteenth century. Aveling used an indiarubber bulb as the auxiliary heart, while he replaced finger pressure for the control of blood flow by stop-cocks.¹⁶

Unfortunately, the bulk of the correspondence between Potter and Aubrey has been lost. Nevertheless the few surviving letters and extracts in the *Brief Lives*, indicate ample grounds for Aubrey's conviction that Potter deserved an important place among the pioneers of transfusion. As might be expected, one of the first to be consulted about transfusion was William Harvey. A note against Potter's earlier letter indicates Harvey's adverse opinion. 'Hanc designationem Dr. Harveus frivolam et impossibilem omnino esse asseruit: sed tamen quaere. Consult Dr. Glisson'.¹⁷

The note was probably written by Aubrey. It would be interesting to know whether the advice to look into the matter and consult Glisson also came from Harvey. The evidence of another letter in which Potter was sending Harvey a piece of agate, indicates that there may have been various transactions between the two men.¹⁸ Glisson would have been consulted, not only as the most distinguished disciple of Harvey, but also because of his current anatomical researches into the anatomy and physiology of the liver and its vascular system. For this he had devised new techniques of anatomical injection and had injected various substances into the vascular system to elucidate metabolic pathways.¹⁹ Both Potter and Glisson were concerned to perfect pipes which could be inserted effectively into veins. One of Potter's letters notes two main *desiderata* as the improvement of 'Crooked pipes' and the more detailed knowledge of the course of the veins.²⁰ Glisson contributed greatly to both goals, his book containing an illustration of the tapering fistula which he had designed for injection experiments.²¹

Taking the injection experiments of Glisson and the transfusion techniques of Potter, it was only a short step to the intravenous injections of drugs by Wren and his associates at Oxford and the transfusion experiments of Lower. Glisson's *Anatomia hepatis* was extremely influential and may well have contributed to the idea of injecting fluids into the superficial veins. Glisson himself used substances having characteristic colours such as milk, or dyes. Similar techniques could be used for the ready introduction of *crocus metallorum* infusion or opium solution into the veins.

Potter's main and possibly sole advocate was Aubrey. It would be surprising if this garrulous figure failed to communicate Potter's transfusion to his numerous scientific acquaintances at Oxford and London. Information about Potter was certainly relayed to Samuel Hartlib one of the other celebrated intelligencers of the period. However, blood transfusion was not among the lists of inventions which Aubrey mentioned between 1652 and 1653.²² Nevertheless, an excerpt from Hartlib's

¹⁶ J. H. Aveling, *Lancet*, 1872, p. 148.

¹⁷ Aubrey MS. 6, f.61r. Plot in his *Analecta* gives a slightly different and possibly more favourable reaction from Harvey; 'In things applyed outwardly by how much the substance is liker, by so much the experiment is better. as warme blood of infants for &c from Dr. Harvey.'

¹⁸ Letter from Potter to Aubrey, 8 May 1656; Aubrey MS. 13, f.152r.

¹⁹ Francis Glisson, *Anatomia hepatis*, London, 1654; chapter 21, 'Duae administrationes anatomicae.'

²⁰ Letter from Potter to Aubrey, 17 November 1652; Aubrey MS. 13, f.144r.

²¹ Glisson, *Anatomia hepatis*, op. cit., 1659, ed. p. 254.

²² Samuel Hartlib, MS. *Ephemerides*, Sheffield University Library. The author is editing this journal for publication.

Ephemerides including information from Aubrey, indicates the rapid communication of scientific information at this time.

Aubrey was especially interested in Mr. Potter the 666. Divine whome he knows intimately and written several Letters unto him to oblige him to communication and publishing of all his Experiments and Inventions, but could never prevaile. He counted that Tract 666. one of his meanest pieces. He commended extraordinarily his new watch without any wheels . . . Besides he said he had many other excellent Inventions as for facilitating of carriages, blowing of mils bellows, withal studying a common or universal character and was also chymically given. He had also an Invention for Threshing but durst not discover or use it for feare of undoing the Poore. Aubrey is also acquainted with Mr. Boyle, and dwels not far from Stalbridge.²³

With such ready flow of information from the West Midlands to London and Oxford, it is easy to see how scientific interests became universally diffused. At the same time it becomes hazardous to attribute discoveries to single agents. The above items attributed to Potter represent the common scientific preoccupations of the period. Even if Aubrey communicated Potter's transfusion experiment, there was a delay before it was repeated. Interest in this experiment rapidly increased in 1665, largely as a logical development of the injection technique. Once Lower had popularized transfusion, Aubrey was anxious to draw attention to Potter. But the Royal Society was primarily interested in refuting French priority claims. Little publicity was given to the distant origins of English blood transfusion. This is somewhat surprising since Potter was elected F.R.S. in 1663, while Lower was not elected until 1667. In these circumstances, Sprat was scarcely justified in claiming transfusion as one of the achievements of the Royal Society, a point pungently stressed by Henry Stubbe.²⁴ Potter was not quite neglected. In his long discussion of the anatomical debates of the period, Timothy Clarke made an oblique reference to Aubrey's letter, suggesting that transfusion was frequently put forward by Potter to Aubrey and others, the idea being stimulated by belief in circulation.²⁵ Clarke thus accorded Potter a greater role than indicated by other contemporaries or later historians. His estimate was probably correct. However, his terminology leaves us in doubt whether Potter performed the experiment successfully. On the evidence presented above, it is obvious that he was very near to success. If transfusion was achieved, and if Aubrey was effective in communicating the technique to other English virtuosi, the early history of blood transfusion requires considerable revision. Blood transfusion may have come before, not as a development of intravenous injection; also the first successful experiments were performed on man rather than animals. In this case Potter would deserve some of the esteem currently shared by Lower and Denis.

CHARLES WEBSTER

²³ Hartlib, *Ephemerides*, 1652. In 1656 Wilkins gave Hartlib information about Potter.

²⁴ Thomas Sprat, *History of the Royal Society*, London, 1667, p. 317. Joseph Glanvill, *Plus Ultra: or the Progress and Advancement of Knowledge*, London, 1668, p. 17. Both attacked in Stubbe's *Plus Ultra reduced to a Non-Plus*, London, 1670, pp. 116–56.

²⁵ Timothy Clarke; a letter inserted in the *Phil. Trans. R. Soc. Lond.*, no. 35, 18 May 1668, pp. 672–82. 'Misso testimonio illo, quod a viro fide digno, & Regalis Societatis consorte, penes Te etiamnum reperitur, viz. Rever. Dominum Potter, Theologum insignem, triginta ab hinc annis, considerata Circulatione Harveana, socio huic nostro & aliis viris doctis, saepius sanguinis Transfusionem proposuisse; Ego equidem, quae mihi ipsi hac de certo cognita sunt, solum referam.' p. 678.