INTRODUCTORY NOTES

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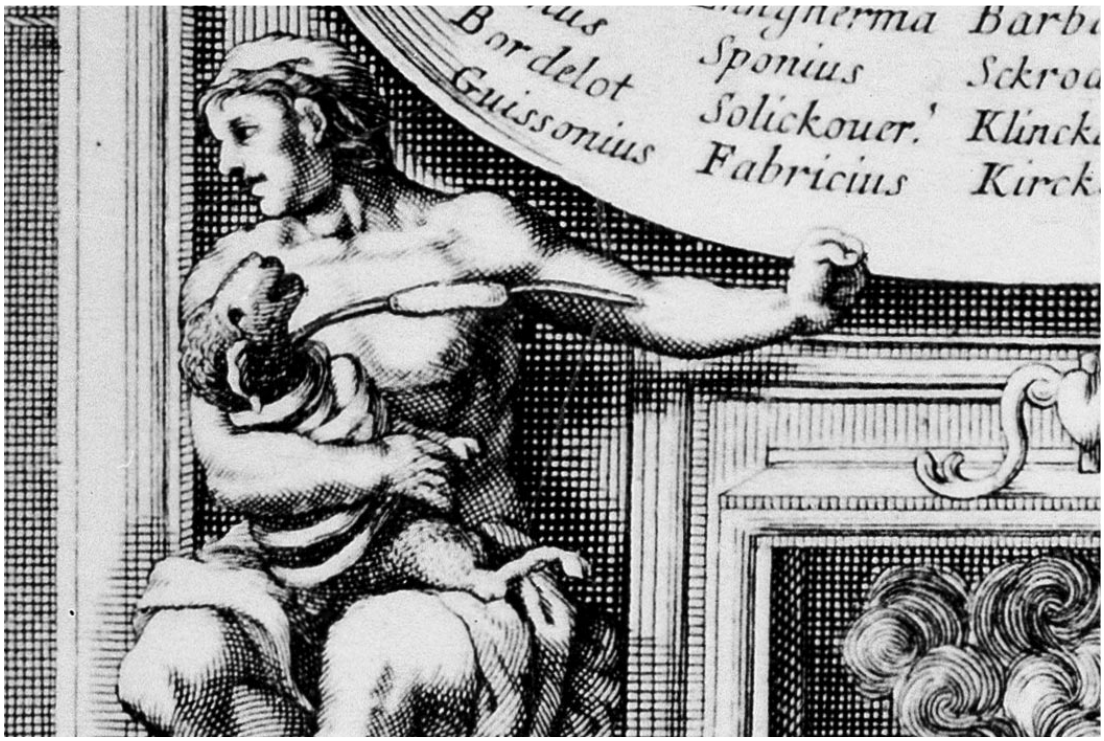
The article examines the views that people had of blood and transfusion in the mid to late seventeenth century, when the early experiments of Lower and Denis were performed and published in the Royal Society journal Philosophical Transactions, and relates them to some of the views expressed today regarding legal ownership, cost and disease transmission that are associated with the transfusion of blood.

FIRST BLOOD TRANSFUSION: A HISTORY

Elizabeth Yale

The world's first experiments with blood transfusion occurred in the mid-1660s in England. The procedure, carried out between dogs, was gruesome.



The world's first experiments with blood transfusion occurred in the mid-1660s in England. The procedure, which was first carried out between dogs, was gruesome: the dogs were tied down, the arteries and veins in their necks opened, and blood transferred from one to another through quills (most likely made from goose feathers) inserted into the blood vessels. The experimentalist started and stopped the flow of

blood by loosening and tightening threads tied with running knots around the dogs' blood vessels. The blood of the "emittent" dog flowed from its carotid artery into a vein in the recipient's neck while the recipient's own blood ran out its carotid artery. According to physician Richard Lower, who described the operation in an essay published in 1666 in *Philosophical Transactions*[1], the world's oldest scientific journal, the transfusion came to an end when the emittent dog began "to cry, and faint, and fall into Convulsions, and at last dye [sic]."

In our own day, blood transfusion has become an accepted, relatively uncontroversial medical therapy. We treat blood as a commodity, swapping units in and out of bodies as necessary. Yet in Lower's time, it was wholly new, and such experiments – which he was one of the first to perform – were met with fear and controversy, much of which hung on a seemingly simple question: when blood passes from one body into another, what does it carry with it?

Shortly after Lower's description of transfusion was published, the natural philosopher Robert Boyle released a series of questions about the effects of transfusion on the dog receiving blood, also in *Philosophical Transactions*[2]. Boyle, like many of the early modern natural philosophers whose writings were published in *Philosophical Transactions*, was affiliated with the Royal Society, a national fellowship then newly founded for the promotion of scientific knowledge. The premise of many of Boyle's questions was that blood transfusion might induce physical, mental, and psychological changes in the animal receiving blood. He asked: does transfusion change a dog of one breed into another? Does it alter a dog's temperament? Can a "fierce" dog be made into a "cowardly" dog? If you transfuse blood from a dog that's just been fed into a hungry dog, will the hungry dog still be hungry? If a dog has been taught to fetch and carry, could those learned behaviors be obliterated by repeated transfusions from untrained dogs? Will a dog with new blood still know its master?

To Boyle, transfusion promised the transformation of the very substance and being of biological creatures. As Holly Tucker recounts in her book *Blood Work: A Tale of Medicine and Murder in the Scientific Revolution*[3], Boyle's questions reflect his interest in alchemical transmutation. Much of Boyle's time was occupied with research in this esoteric science, the forerunner of modern chemistry. He actively sought the philosophical mercury, a compound that would transform base metals into gold. He once thought he had approached it when he observed how a small amount of quicksilver, mixed in the palm of his hand with gold dust, grew hot enough to melt the gold[4]. In transfusion research, Boyle saw the possibilities for alchemical transmutations within living beings: when blood was transferred between bodies, he asked, what powers were carried with it? What made a living creature unique? Were the physical and mental components of identity in the blood?

Following Lower's experiments, researchers were eager to leap forward, to try transfusing blood into a human subject. Yet, how to do it?[5] They debated the procedure on and off throughout 1666 and most of 1667. Given that the procedure usually killed the "emittent," a human-to-human transfusion was not possible. It was settled that a sheep would be the source of the blood for the Royal Society's first transfusion into a human subject.

But the choice of a human recipient was more difficult. The Royal Society needed someone who was clearly unwell in some way: then they could make the argument that transfusion might improve his health. They also sought an educated person who could report reliably on transfusion's effects on his body. Ultimately, they settled on Arthur Coga, mentally unstable, but educated – he knew Latin, and had spent some

time as a clergyman. Coga's mental illness might be cured by transfusion; yet it tended to render him unfit to report on the bodily experience of the procedure. The experiment was troubled from the start.

The Fellows of the Royal Society speculated that perhaps transfusion would "cool" Coga's blood, restoring order to his mind. Such things had been seen before: blood was not the only body fluid with transmutationary potential. According to naval administrator Samuel Pepys, also a member of the Royal Society, at one meeting, a gentleman told a story of an old man who lived only on "woman's milk," finding that stronger food was too much for him[6]. The milk affected his temperament. When he received it from an "angry, fretful woman," he was an angry, fretful man. When she was "good-natured, patient," he found himself so, as well.

In late 1667, as the Society moved forward with the research, things seemed to go well, at least initially: the Society paid Coga 20 shillings, according to Pepys, who thought it too little, given the danger inherent in the experiment. Lower and the physician Edmund King, who performed the operation, judged that Coga received 9 or 10 ounces of the sheep's blood, passed from one body to the other through quills joined to silver pipes[7]. A few days after his transfusion, Coga reported to the Society on its effects, presenting his remarks in Latin. Shortly thereafter, Pepys met Coga at a dinner party: he found that Coga spoke "very reasonably, and very well," though he was "cracked a little in his head."[8]

But this relatively good report did not last: following a second transfusion, the research was soon stymied by public mockery and Coga's apparent failure as a model experimental subject. Raucous gawkers in London's unruly coffeehouses "endeavoured to debauch" Coga, as one observer wrote to another, and he spent his 20 shilling fee on drink. Alcohol was not only believed to blur the effects of the transfusion; more importantly, thus "debauched," Coga was rendered totally unfit as a witness to the procedure's effects on his body. A few months later, in France, the recipient of a blood transfusion died following the procedure. (He was poisoned with arsenic, his murder most likely orchestrated by Parisian physicians who opposed transfusion, a tale Holly Tucker tells in her book.) Blood transfusion research came to a halt – though not formally outlawed in England, as it was in France, the Fellows of the Royal Society gave it up.

Though the research stopped, the mockery did not. A decade later, in June 1676, Thomas Shadwell published the text of his popular play satirizing the Royal Society, *The Virtuoso*, which made fun of sheep-to-human blood transfusion. Shadwell played on transfusion's transmutationary possibilities. In the play, Sir Nicholas Gimcrack, the virtuoso of the title, took transfusion a step further than Lower's original experiment, fully exchanging blood between a mangy spaniel and a healthy bulldog. Far from killing either of the animals, this experiment transformed the healthy bulldog into a mangy spaniel, and vice versa. Gimcrack further boasted of experiments with cross-species transfusion, announcing that he was on the path to creating a flock of wool-bearing, bleating humans, from which he proposed to source the wool for his clothes. One of the characters, a skeptic, cracked that "if the blood of an Ass were transfused into a Virtuoso, you would not know the emittent Ass from the Recipient Philosopher."

Gimcrack's experiment with the mangy spaniel and the sound bulldog seems to poke fun specifically at Boyle's questionnaire – one imagines the playwright madly taking notes as he read issues of *Philosophical Transactions* in the library of Welbeck Abbey, the estate of his wealthy patron, William Cavendish, Duke of Newcastle. Fellows of the Society who saw the play were deeply mortified. The experimenter

Robert Hooke felt that members of the audience gawked and pointed at him openly during the performance that he attended.

Looked at one way, this episode represents a failure for the early Royal Society. The fellows' ambitions – and imaginations – outran not only what the public was willing to support, but also reality itself. Transfusion never induced an observable transmutation in the animals – or people – subjected to it, and the negative public response put a stop to transfusion research for over a century.

Yet, if we return to the initial publication of Lower's procedure, and Boyle's questions, the episode can also be seen as a success. In its 350th year, *Philosophical Transactions* is now the world's oldest scientific journal. Scholarly journals, more generally, have become important tools for advancing knowledge across academic fields. At the time of its invention, though, it was a new sort of beast, an attempt at scientific communication born of Royal Society secretary Henry Oldenburg's desire to encourage scientific research and make a living while doing so. Oldenburg's journal[9] shared experimental results and queries publicly, introducing them to a paying readership broader than that which could be easily reached through face-to-face conversation and personal correspondence. Oldenburg, in publishing Lower's results and Boyle's questions, powered an international wave of transfusion research, much of which was coordinated through and reported in the *Philosophical Transactions.*

Whether we judge this episode a "success" or not, can it be safely laid in the past? To what extent have we moved beyond our discomfort with blood transfusion, even as the medical use of "body products," as legal historian Kara W. Swanson terms them, has expanded wildly? In her recent book, *Banking on the Body: The Market in Blood, Milk, and Sperm in Modern America*,[10] Swanson tells the story of Cook County Hospital, Chicago physician Bernard Fantus, who in 1937 first described a repository of donated blood as a "bank," setting off an entanglement between blood, markets, and money that has since spread to other body products – milk, organs, semen, and human eggs – and continues to complicate therapeutic uses of these substances and disturb our consciences.

In the first US blood banks, physicians segregated the blood of black donors from that of white donors, following white Americans' fears that blood carried with it a force for racial transmutation. In the present, the Food and Drug Administration bars non-celibate gay men from donating blood. Some see homophobia in this measure, though the FDA argues that it is necessary to prevent the spread of HIV[11]. With the first successful face transplant having been conducted in France in 2005, even faces have become "body products," raising anew questions about the relationship between the physical makeup of our bodies and our identities as individuals. The question arises again and again – or perhaps we've never really left it behind: when blood – or any bodily tissue – is transferred from one body to another, what does it carry with it?

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Figure 1

Figure 1: The first human transfusions were conducted in Paris, by Jean-Baptiste Denis, and in London, by Richard Lower and Edmund King, in 1667. Image: Matthias Gottfried Purmann, Grosser und Gantz neugewundener Lorbeer-Krantz, oder Wund Artzney (Frankfurt, 1705). Credit: Wellcome Library

Figure 2

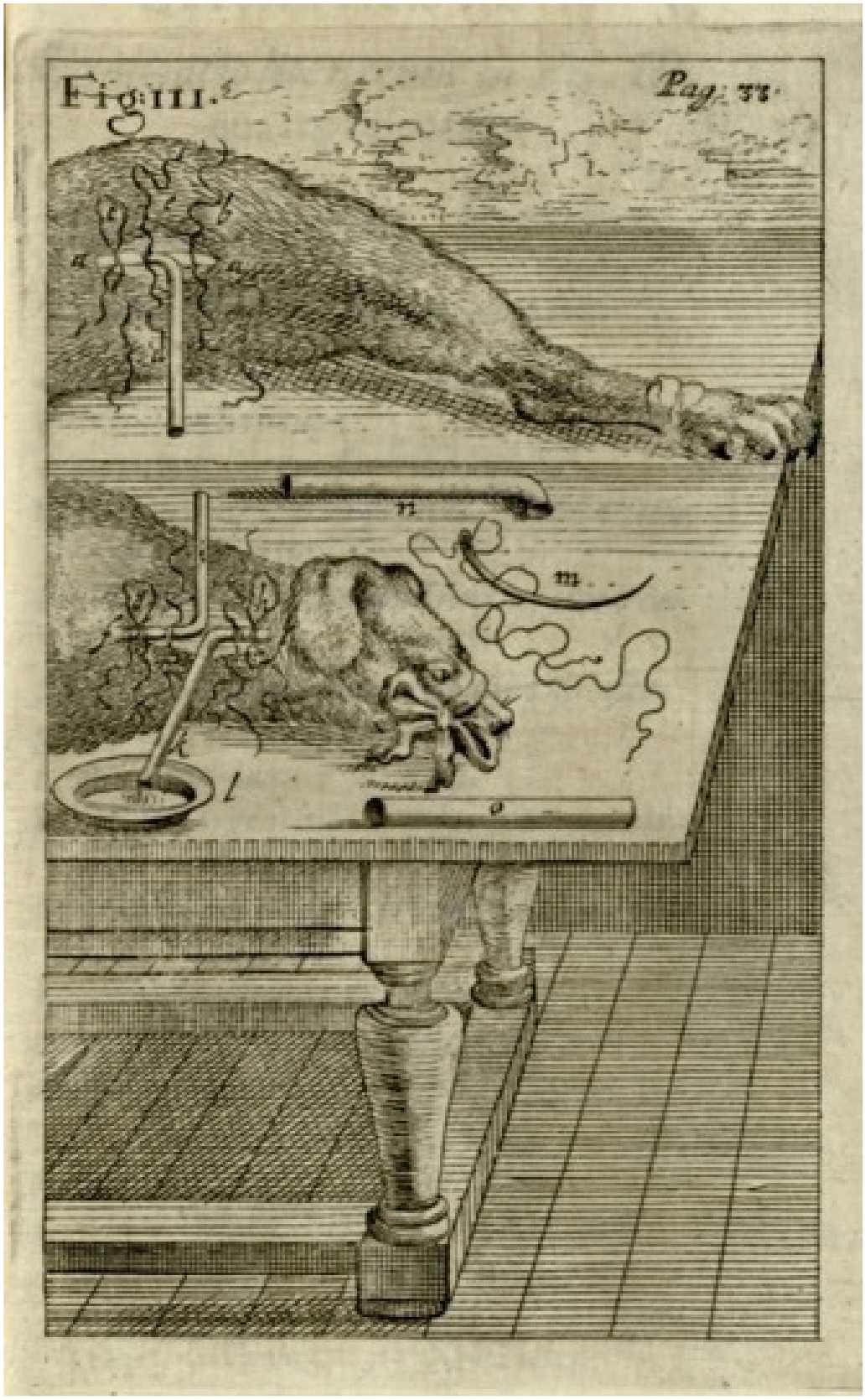


Figure 2: Before human transfusion was undertaken, tests were conducted with dogs, first by English physician Richard Lower. Image: Johann Sigismund Elsholtz, Clysmatica nova (Brandenburg, 1667). Credit: Historical Medical Library of the College of Physicians of Philadelphia.

Figure 3

Figure 3: Before attempting transfusion, natural philosophers, like Christopher Wren, experimented with injecting substances (including milk, wine, ale, broth, and opium) directly into the blood stream of animals. Image: Johann Sigismund Elsholtz, Clysmatica nova (Brandenburg, 1667), plate 1. Credit: Historical Medical Library of the College of Physicians of Philadelphia.

Figure 4

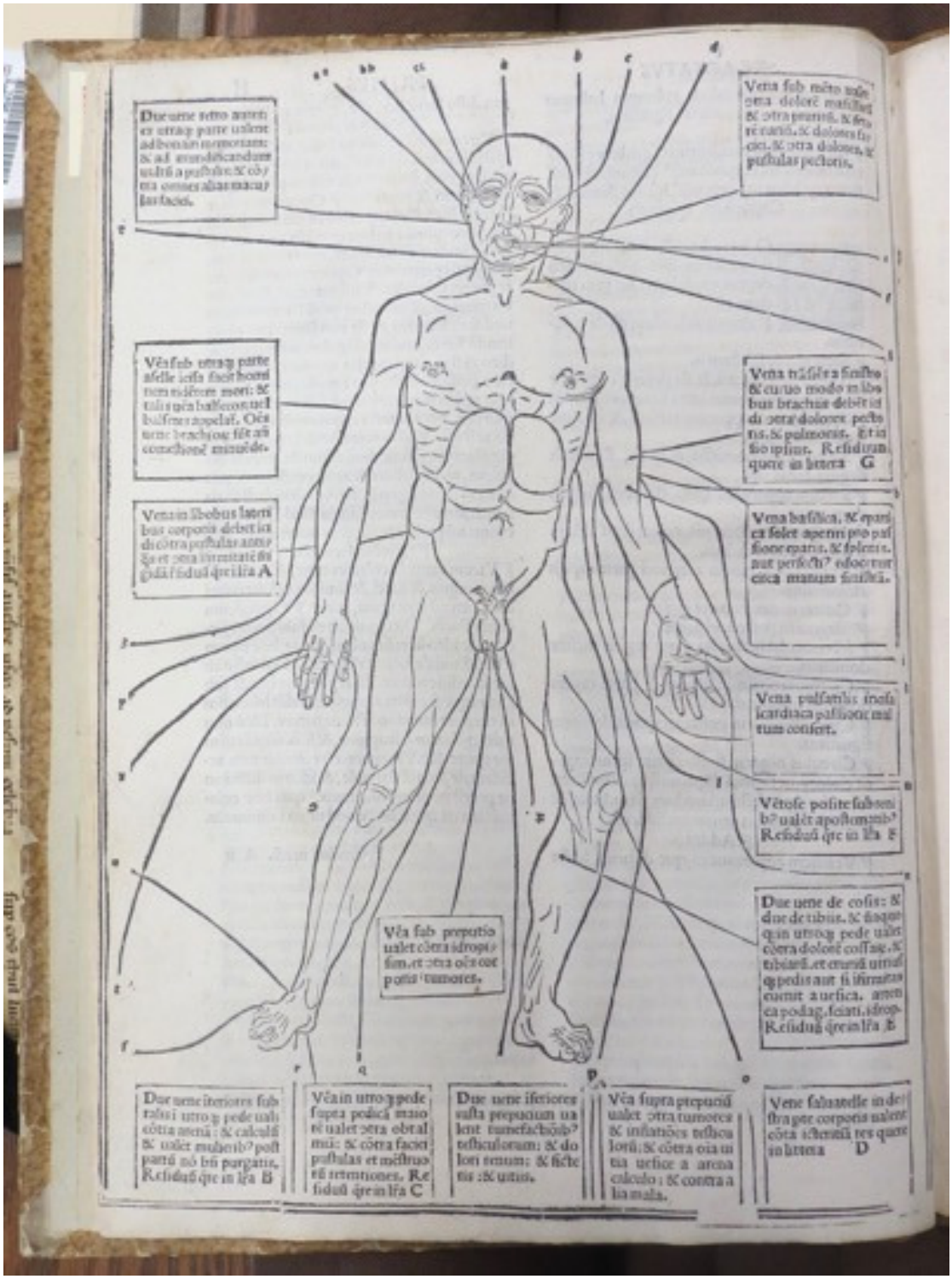


Figure 4: Prior to Harvey's discovery, the consensus was that the liver manufactured blood, from whence it was transported to the heart by the veins. Image: Johannes de Kethem, Fasciculus Medicie (Venice: Per Cesarum Arrivabenum, 1522). Credit: John Martin Rare Book Room, University of Iowa.

Figure 5

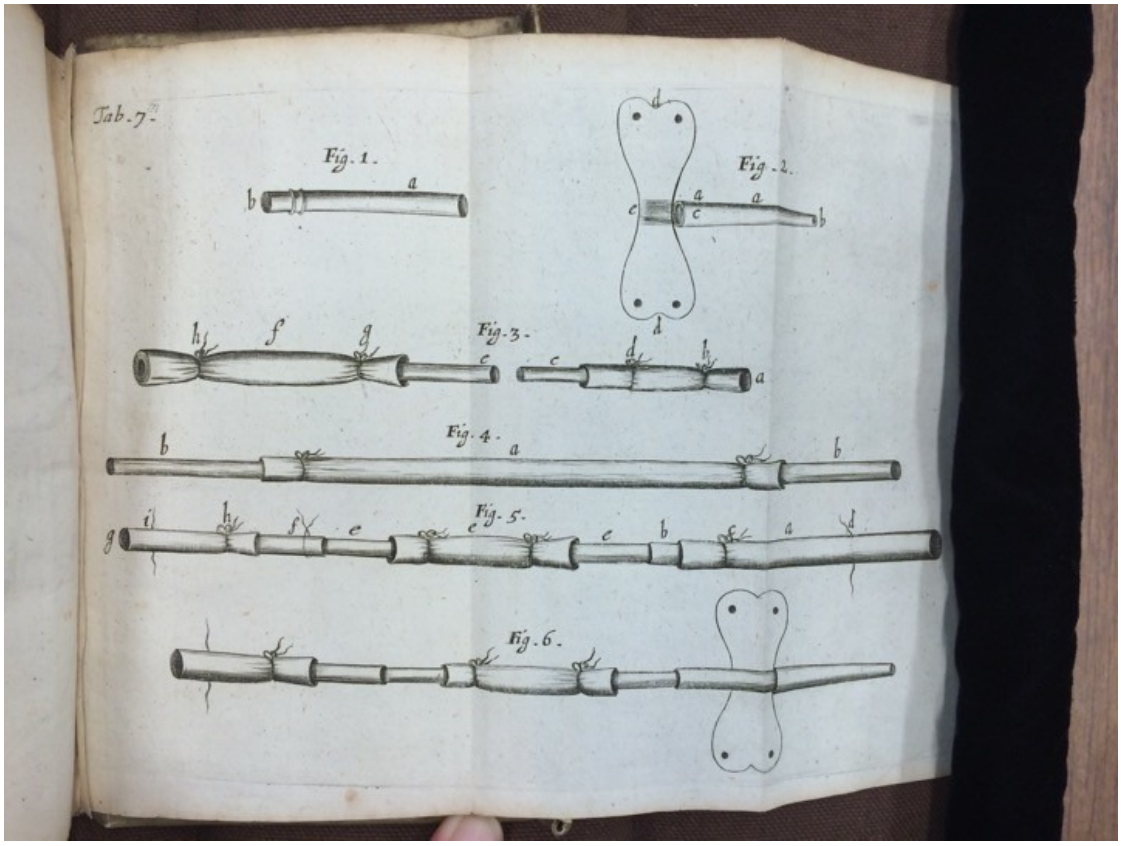
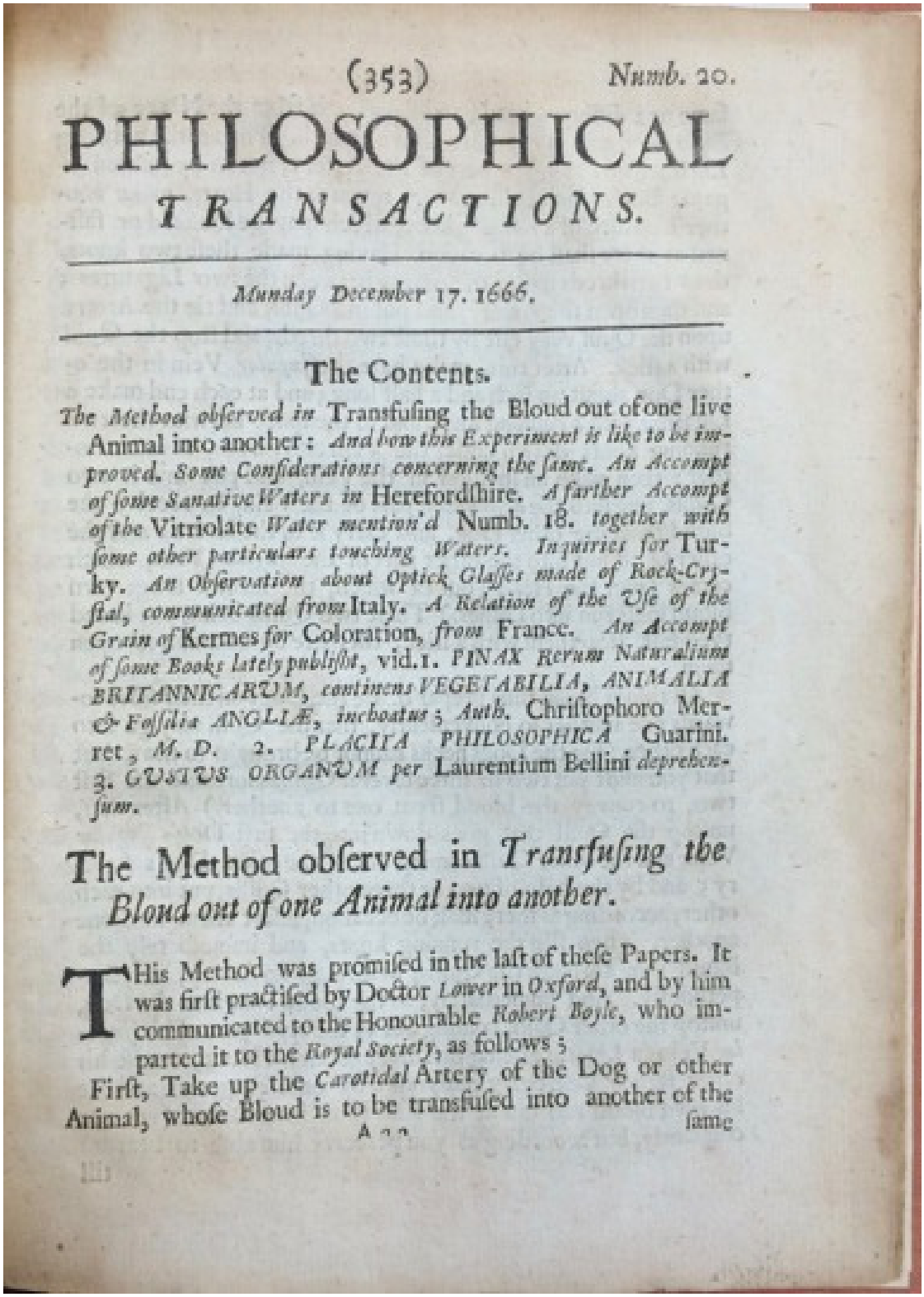


Figure 5: Richard Lower's apparatus for connecting the artery and vein of emmitent and recipient during a transfusion. Image: Richard Lower, Tractatus de Corde item De Motu & Colore Sanguinis (Amsterdam: Danielem Elzevirium, 1669). Credit: John Martin Rare Book Room, University of Iowa.

Figure 6



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PHILOSOPHICAL TRANSACTIONS.

Munday December 17. 1666.

The Contents.

The Method observed in Transfusing the Bloud out of one live Animal into another: *And how this Experiment is like to be improved. Some Considerations concerning the same. An Accompt of some Sanative Waters in* Herefordshire. *A farther Accompt of the* Vitriolate *Water mention'd* Numb. 18. *together with some other particulars touching Waters. Inquiries for* Turky. *An Observation about Optick Glasses made of Rock-Crystal, communicated from* Italy. *A Relation of the Use of the Grain of* Kermes *for* Coloration, *from* France. *An Accompt of some Books lately publisht,* vid. 1. *PINAX Rerum Naturalium BRITANNICARUM, continens VEGETABILIA, ANIMALIA & Fossilia ANGLIÆ, inchoatus;* Auth. Christophoro Merret, *M. D.* 2. *PLACITA PHILOSOPHICA* Guarini. 3. *GUSTUS ORGANUM per* Laurentium Bellini *deprehensum.*

The Method observed in *Transfusing the Bloud out of one Animal into another.*

THis Method was promised in the last of these Papers. It was first practised by Doctor *Lower* in *Oxford*, and by him communicated to the Honourable *Robert Boyle*, who imparted it to the *Royal Society*, as follows;

First, Take up the *Carotidal* Artery of the Dog or other Animal, whose Bloud is to be transfused into another of the same

A 22

Figure 6: At the request of natural philosopher Robert Boyle, Richard Lower published his description for transfusing blood between dogs in The Philosophical Transactions, the journal of the Royal Society of London. Credit: John Martin Rare Book Room, University of Iowa.

Figure 7

Figure 7: Research into blood transfusion and intravenous injection was inspired by William Harvey's discovery that blood circulates through the body, out from the heart through the arteries and back to the heart through the vein. Credit: William Harvey, De Motu Cordis (Frankfurt, 1628). Credit: Wellcome Library.

Figure 8

Figure 8: In the ancient and medieval world, bodily health was further grounded in a system of humors (blood, black bile, yellow bile, and phlegm). Image: Johannes de Kethem, Fasciculus Medicie (Venice: Per Cesarum Arrivabenum, 1522). Credit: John Martin Rare Book Room, University of Iowa.

Figure 9

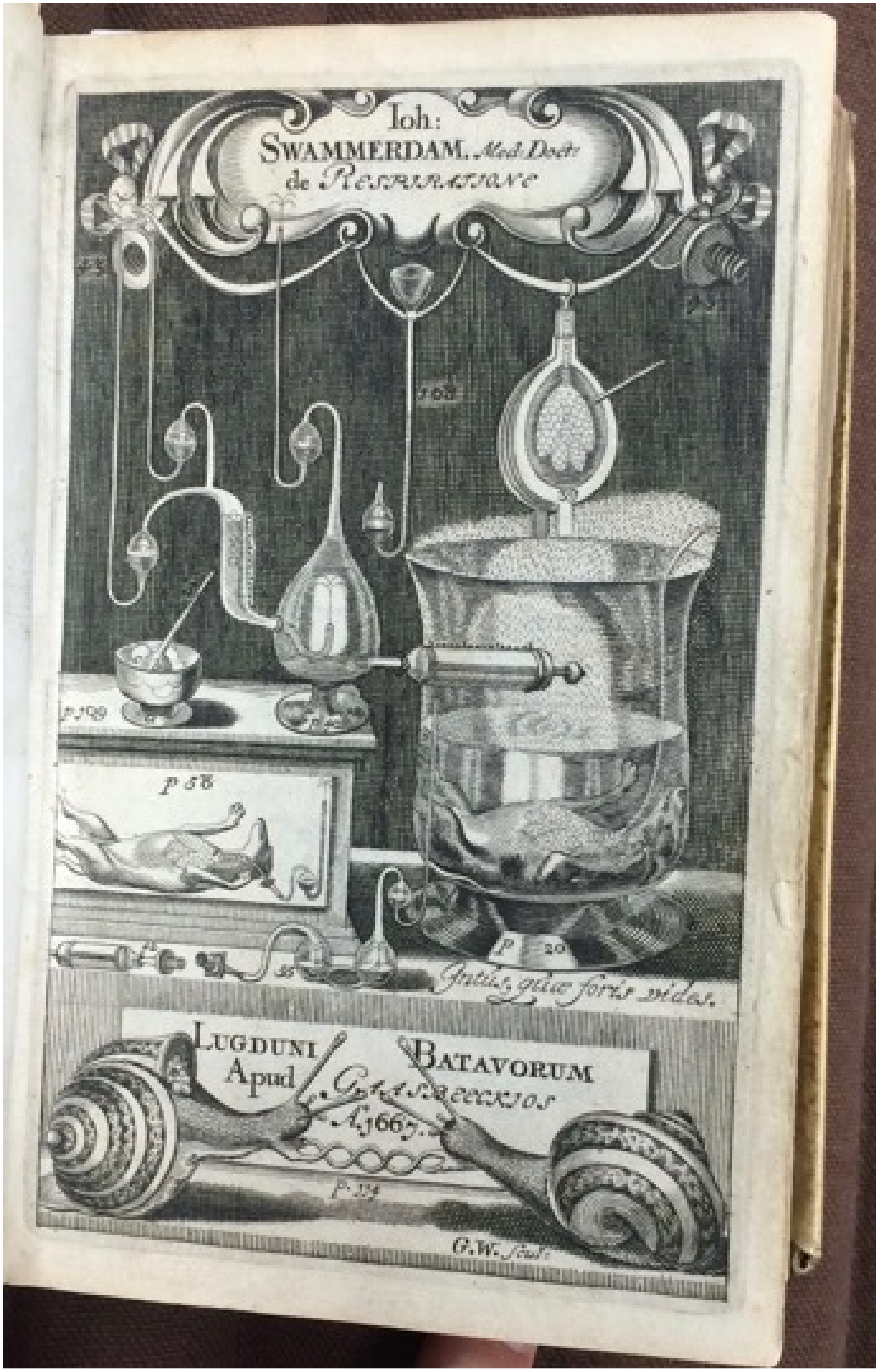

Figure 9: In the 17th century, William Harvey's discoveries were one of several factors that encouraged a new view that the body was a machine. Image: Jan Swammerdam, Die Respiratione (Leiden: Apud Danielem, Abraham & Adrian, à Gaasbeeck, 1667). Credit: John Martin Rare Book Room, University of Iowa.

Figure 10

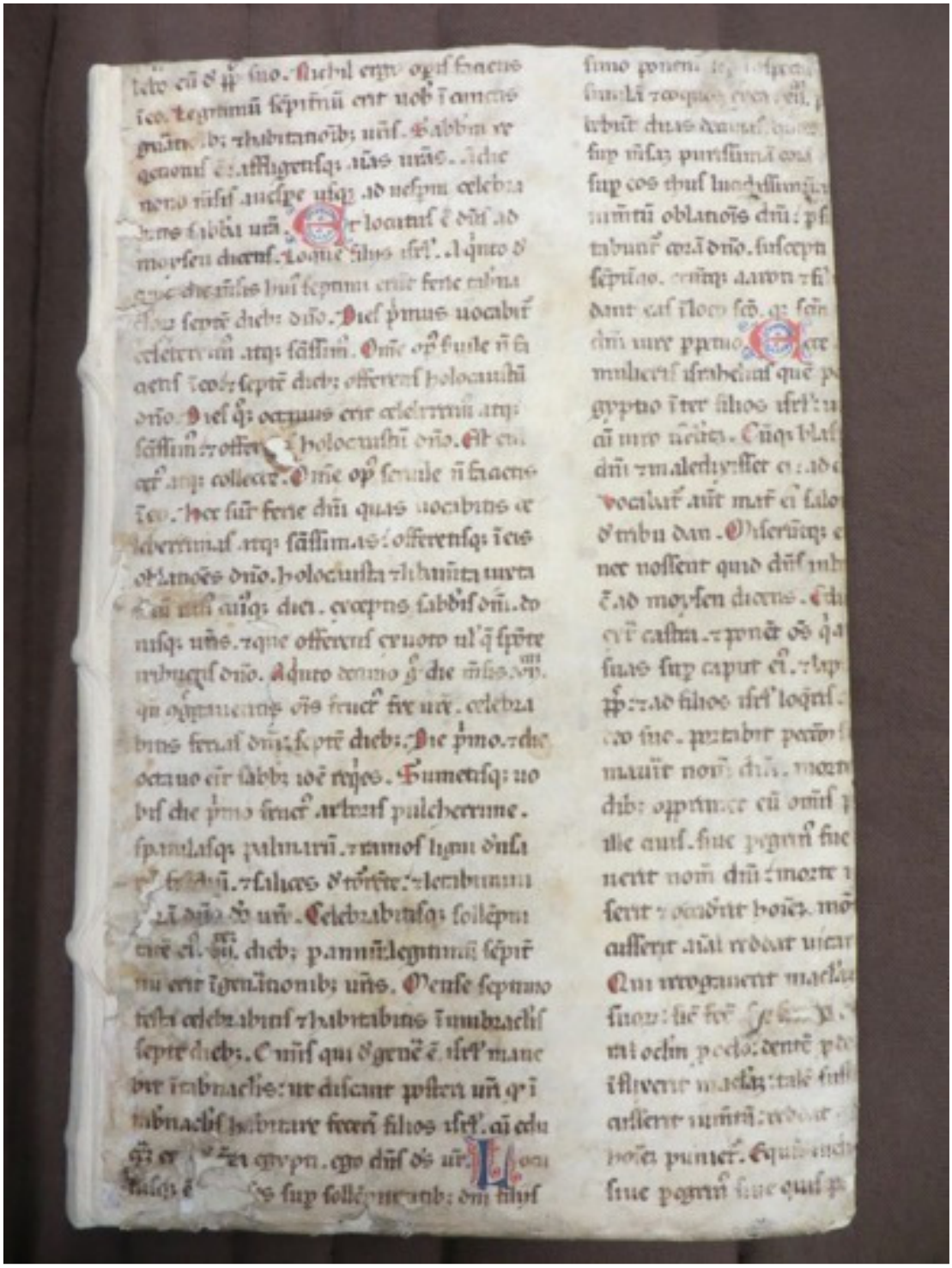

Figure 10: Renaissance physicians derived their ideas about blood and health from ancient and medieval sources. Image Credit: John Martin Rare Book Room, University of Iowa.

Figure 11

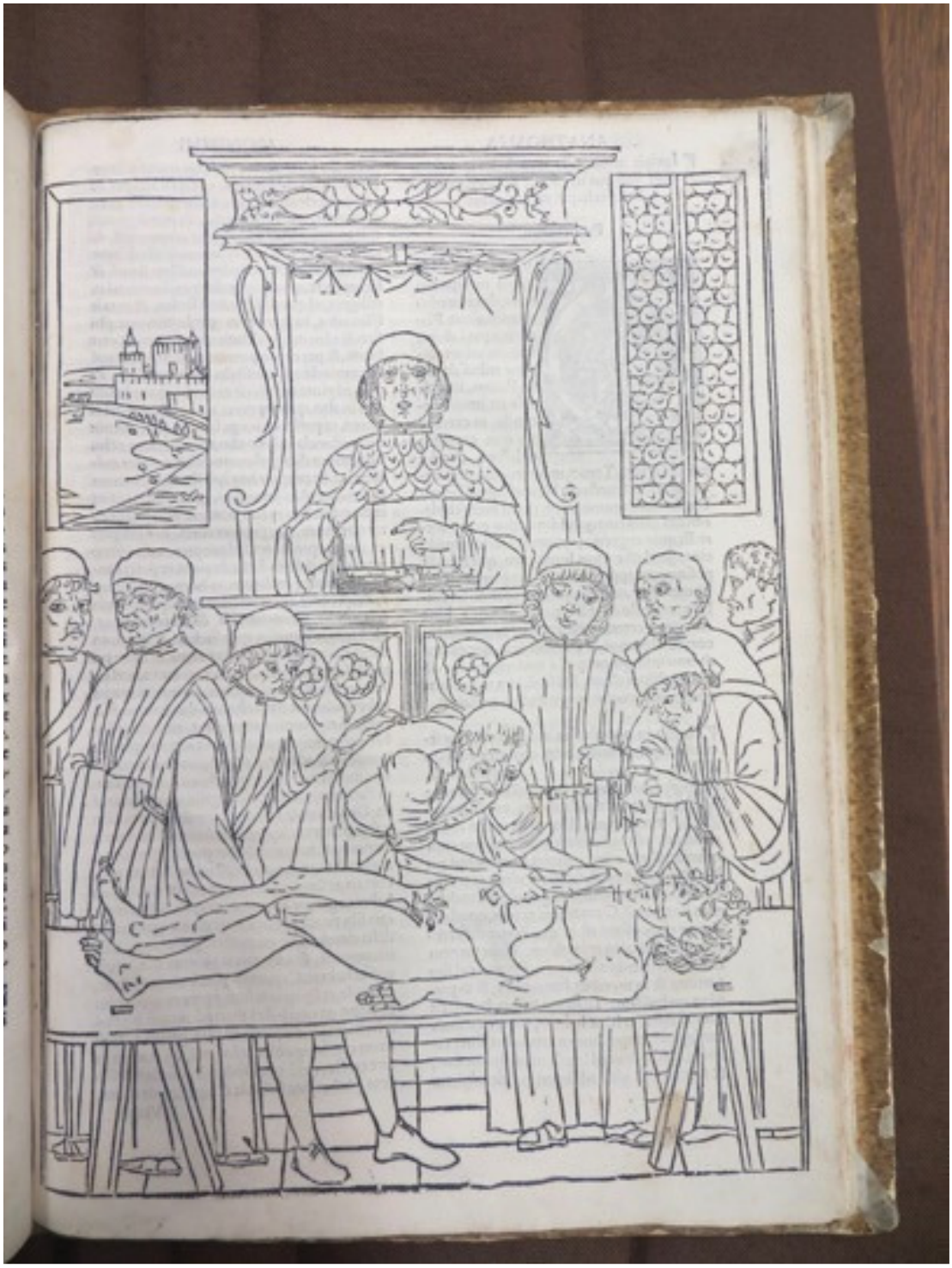

Figure 11: In the medieval world, surgery and medicine were generally separate professions. Credit: John Martin Rare Book Room, University of Iowa.

Figure 12

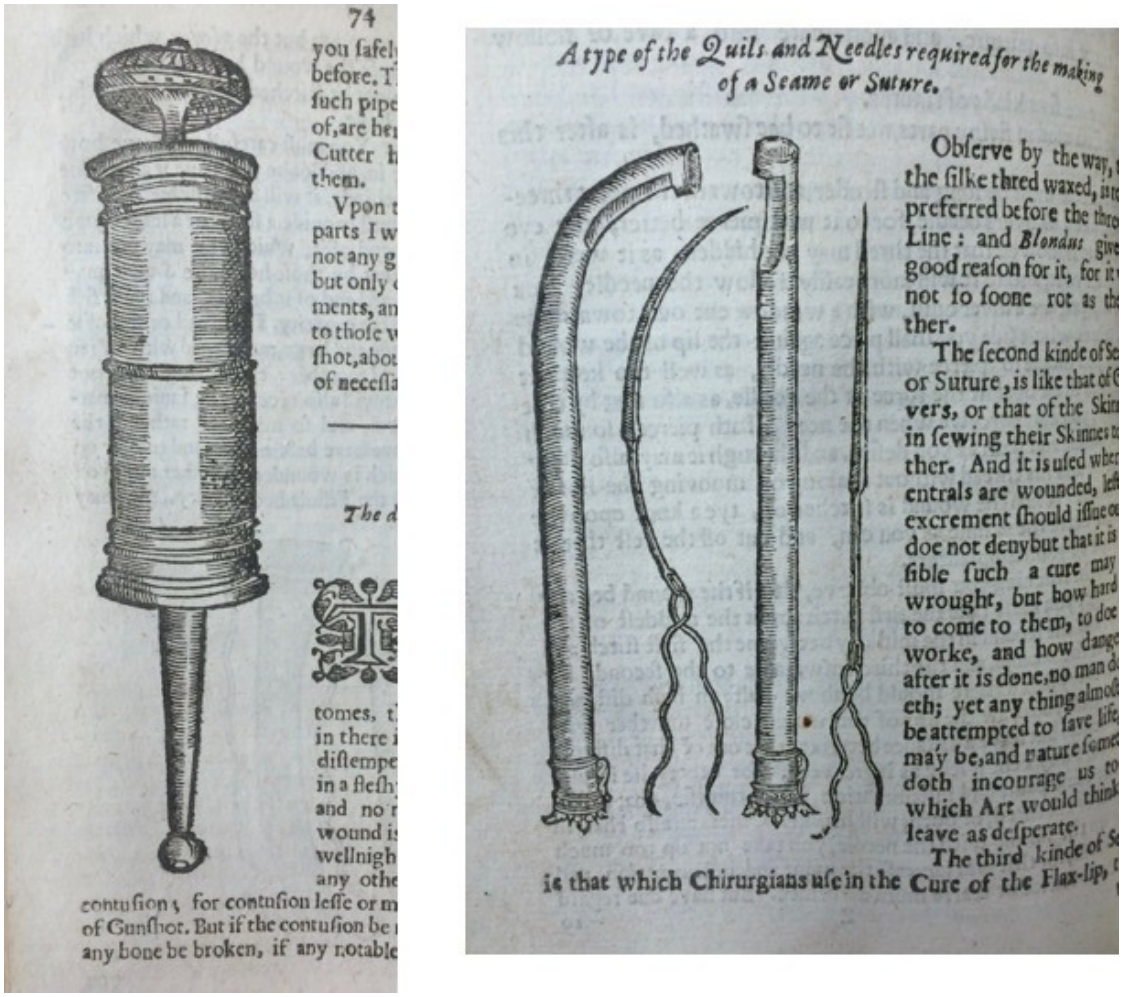

Figure 12: Early modern anatomists sought to bring hands-on surgical skills and medical knowledge into closer contact with each other. Image: Helkiah Crooke, An Explanation of the Fashion and Use of Three and Fifty Instruments of Chirurgery, gathered out of Ambrosius Pareus (London: Michael Sparke, 1634). Credit: John Martin Rare Book Room, University of Iowa.

Figure 13

Figure 13: Intravenous infusion experiments were also conducted with human subjects. Image: Johann Sigismund Elsholtz, Clysmatica nova (Brandenburg, 1667). Credit: Historical Medical Library of the College of Physicians of Philadelphia.

Figure 14

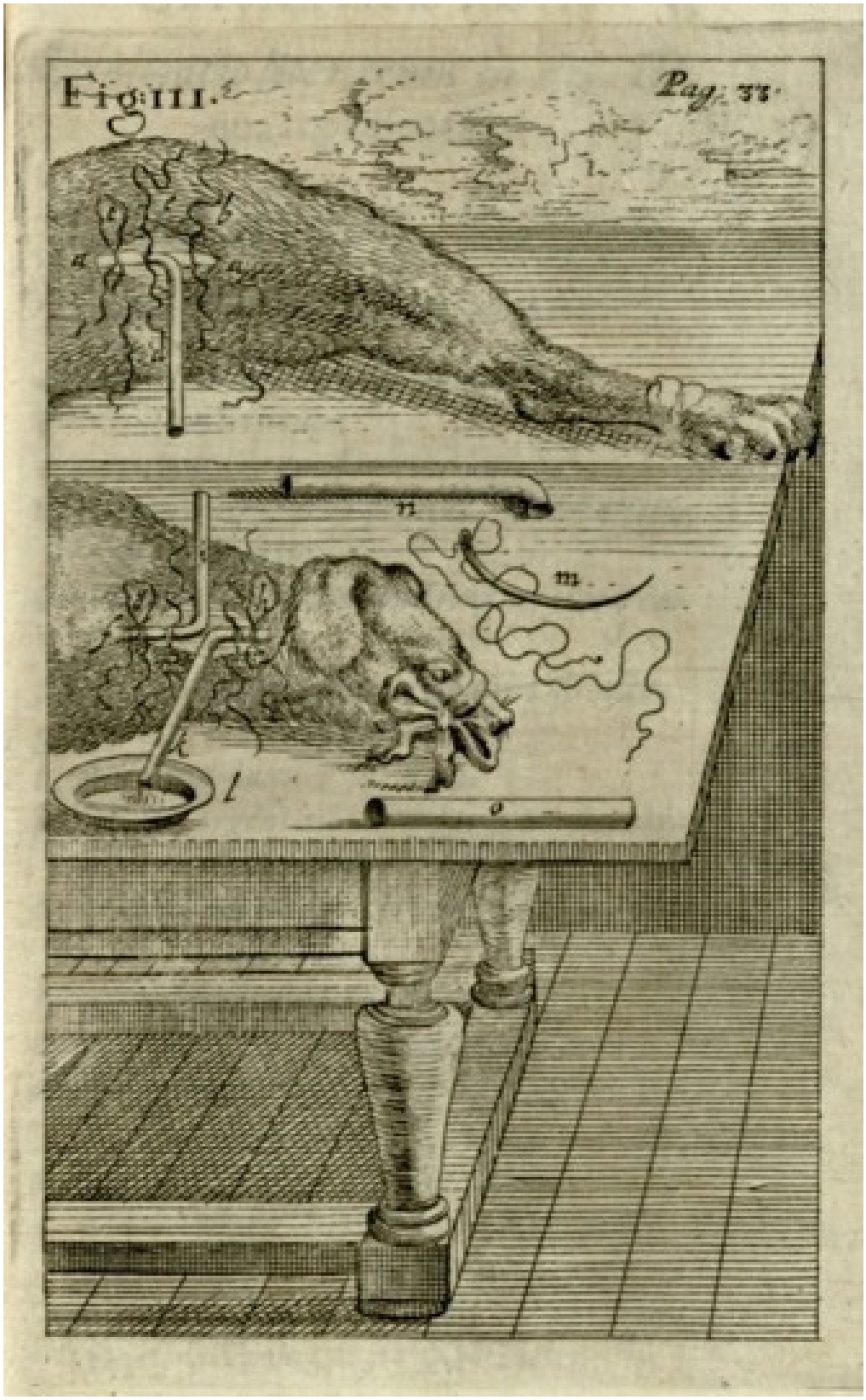

Figure 14: Shortly after Lower's description of transfusion was published in Philosophical Transactions, Robert Boyle released a series of questions about the effects of transfusion on the recipient. Image: Elsholtz, Clysmatica nova (Brandenburg, 1667). Credit: Historical Medical Library of the College of Physicians of Philadelphia.

Figure 15

Figure 15: Following Richard Lower's public demonstration of dog-to-dog transfusion, the Royal Society struggled to find an individual willing to subject himself to transfusion. Image: Georg Abraham Mercklin, Ortu et Occasu Transfusionis (Nuremberg, 1679), frontispiece. Shows three scenes of transfusion. Credit: John Martin Rare Book Room, University of Iowa.

Figure 16

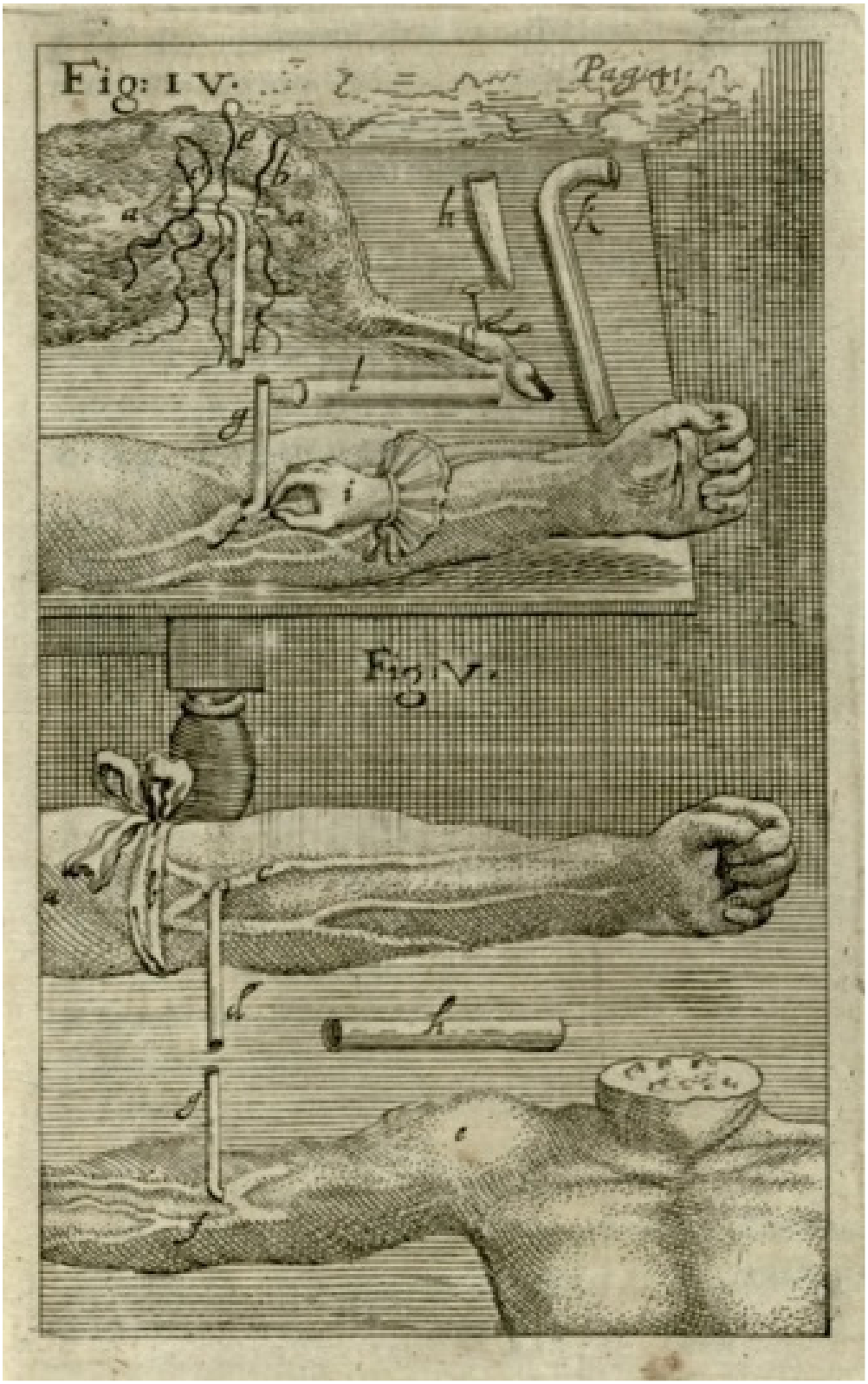

Figure 16: Transfusion was bloody, painful and messy. Image: Johann Sigismund Elsholtz, Clysmatica nova (Brandenburg, 1667). Credit: Historical Medical Library of the College of Physicians of Philadelphia.

Figure 17

Figure 17: This image illustrates a “goat with the face of a human”, one of a series of hybrid, “monster births” Ulisse Aldrovandi depicted in his History of Monsters (Bolognia: Nicolai Tebaldini, 1642). Credit: John Martin Rare Book Room, University of Iowa.

Figure 18

Figure 18: Transmutationary fears and desires plated on existing beliefs in monsters. Image: Ulisse Aldrovandi, History of Monsters (Bolognia: Nicolai Tebaldini, 1642). Credit: John Martin Rare Book Room, University of Iowa.

Figure 19

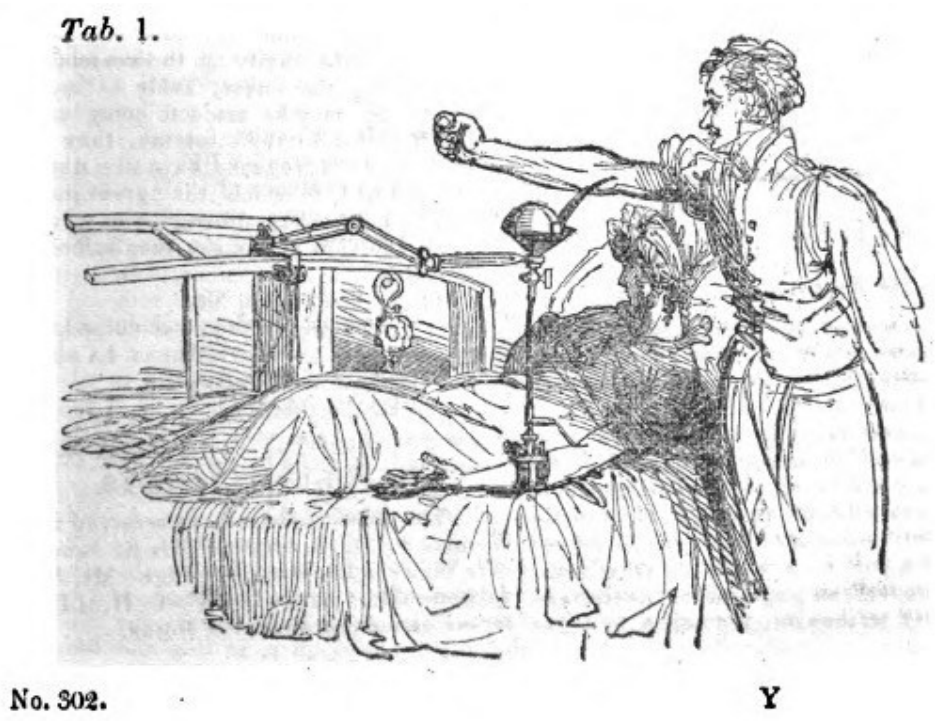

Figure 19: In the early 19th century, obstetricians initiated research into blood transfusion as a way of saving the lives of women who hemorrhaged in childbirth. Image: James Blundell, "Observations on the Transfusion of Blood", The Lancet, Saturday, June 13, 1829. Credit: Wellcome Library.

Figure 20

Figure 20: An improved version of James Blundell's Gravitator, manufactured by an instrument firm in St. James's Street, London. Credit: Wellcome Library.

Figure 21

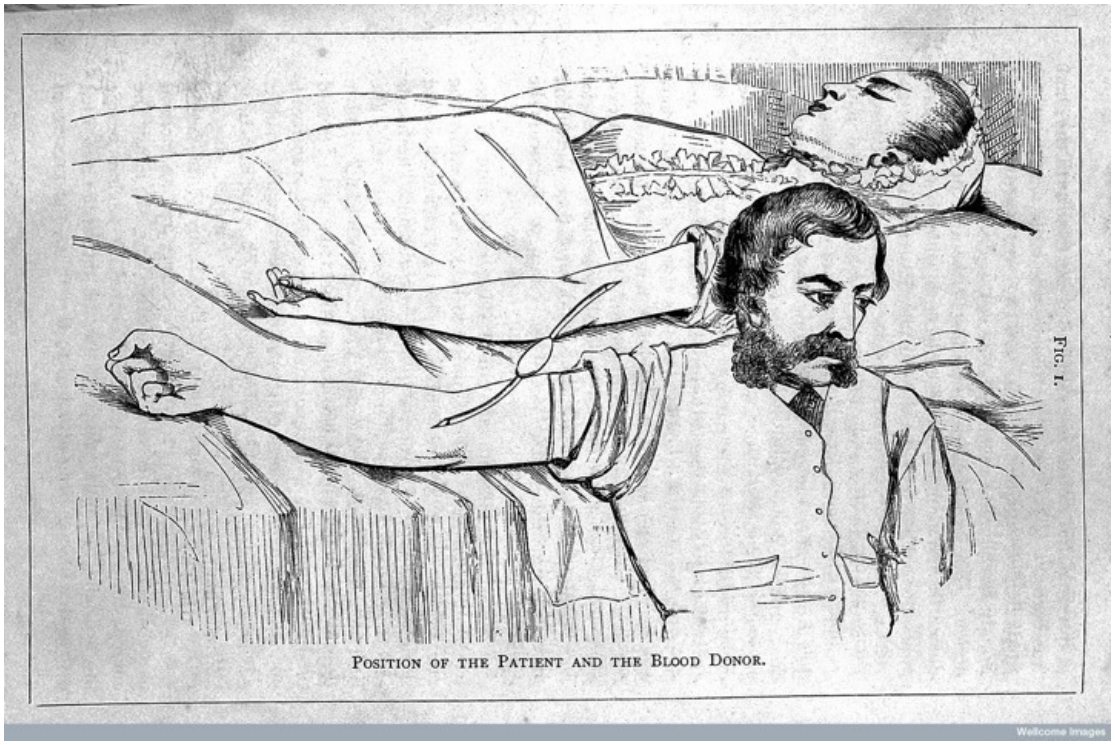

Figure 21: In the last third of the 19th century, the obstetrician James Hobson Aveling invented this blood transfusion device, a small india-rubber tube for emergency blood transfusions. Credit: Wellcome Library.

Figure 22

Figure 22: Physician Geoffrey Keynes invented this portable transfusion apparatus for use on the battlefield during World War 1. Credit: Wellcome Library.

Figure 23

Figure 23: Blood donation as patriotic duty, as reflected in a WWII-era British poster calling for blood donors. Credit: Wellcome Library.