

‘DIE TRANSFUSION DES BLUTES’

By: Dr LEONARD LANDOIS

‘HISTORY OF TRANSFUSION’

A TRANSLATION OF PAGES 1 - 26 BY PHIL LEAROYD

The book ‘The Transfusion of Blood’ by Dr. Leonard Landois, published in Leipzig in 1875, includes the sub-heading: ‘An attempt to establish a physiological justification based on our own experimental investigations with consideration of the history, the indications, the operative technique and the statistics’.

A copy of the 1875 version of this book can be viewed or downloaded from the following sites:

<https://dlcs.io/pdf/wellcome/pdf-item/b21063023/0>

https://openlibrary.org/books/OL24972761M/Die_Transfusion_des_Blutes

The book, of over 350 pages, includes a background ‘history of blood transfusion’, which Landois breaks down into four sections, i.e.

Introduction to the History of Transfusion	pages 1 - 4
The first transfusion trials in England	pages 5 - 12
The first transfusion trials in France	pages 13 - 21
The first transfusion attempts in Italy, Germany and Holland	pages 22 - 26

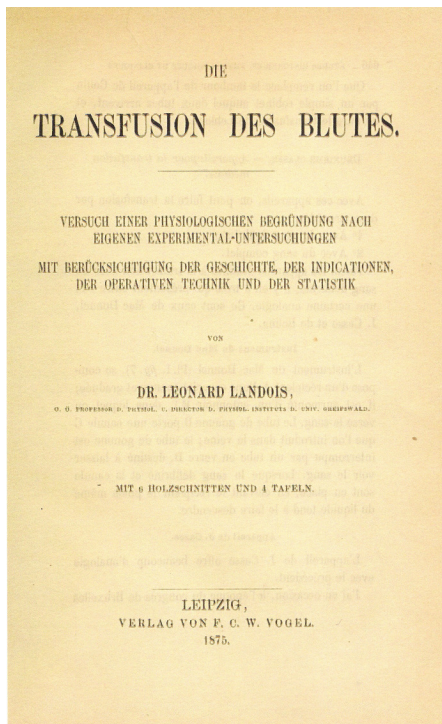
I have translated these four sections of this book from the original German into English in the hope that the content may be appreciated by a wider audience. Whilst I am obviously aware that instantaneous computer-generated translation is possible, this process struggles with specialist terminology and also produces a ‘colloquial style’ not always representative of the original text. I have purposely produced this translation to be ‘un-interpreted’, in that I wanted to maintain the author’s original meaning / wording as much as possible. As with any translation the wording may be purposely or inadvertently altered to ‘make it read better’ but in doing so there has to be an element of personal interpretation involving something on the lines of ‘I believe that this is what the author is actually trying to say’. I wanted to avoid that as much as possible and try to present what the author actually wrote and as a result the reader may find that the English text does not ‘flow’ as well as it could. Whilst some of the words / terms originally used are obviously open to interpretation, I have attempted wherever possible to hopefully maintain the author’s meaning, intent and detail. Although I have taken great care not to misrepresent the author’s original wording I cannot guarantee that this work does not contain ‘translational errors’ and the reader is recommended to check specific details against the original German text.

I have included Landois’ actual spelling of the names of people and places as they appear in the book and where necessary have added amendments to these in square brackets directly after. I have maintained the original paragraph settings. The references to the text within the book are included at the bottom of each page; I have sequentially renumbered them and reproduced them as written at the end of this translation.

LEONARD LANDOIS

Leonard Landois (1837-1902) was a German physiologist. He studied medicine at the University of Greifswald and later became a professor and director of the Institute of Physiology at Greifswald and a member of the German Academy of Sciences Leopoldina. Although his early work involved research in the field of parasitology, Landois was a pioneer in the study of blood transfusion. In 1874-5 he demonstrated inter-species incompatibility of blood by showing that the serum from one species of animal was capable of agglutinating or haemolysing the red cells of an animal of another species. He also linked this phenomenon with the appearance of black urine after a heterologous blood transfusion, establishing scientifically the dangers of transfusing blood of another species into humans. Extensive details of his *in vitro* inter-species experiments are included in a section of 'Die Transfusion des Blutes'.

It is no surprise therefore, given his interest in inter-species incompatibility, that Landois makes the point in a number of places during his historical resume regarding the observation that heat was frequently noted to have occurred along the person's vein when they were being transfused with animal blood. He does however also, from a German's viewpoint, give an interesting comparison between the English and French approach to the early development of transfusion, by especially comparing the work of members of the 'Royal Society' (particularly Robert Boyle) in England and the antagonism shown towards the work of Jean Baptiste Denis in France – and provides background information regarding both these situations. Although he does comment on ancient references to transfusion in various different texts he, like many others, strongly believes it highly unlikely that a transfusion could have been performed before Harvey's discovery of the 'great circulation of blood'.



Title page of Die Transfusion des Blutes (1875)
(Image credit: Wellcome Collection)



Leonard Landois
(Photo credit: en.wikipedia.org)

INTRODUCTION TO THE HISTORY OF TRANSFUSION Leonard Landois (1875)

The history of the first beginnings of that operation, which was given the name "transfusion of blood" by the English researchers who carried it out, is intimately connected with the history of the discovery of blood circulation. Hence England, the fatherland of the great William Harvey, can be called its cradle. In fact, it was only then that the introduction of blood into veins could be properly grasped and appreciated, since it established in which path it flows through the body.

Of course, the transfusion of the blood is also not lacking in a fable story and in certain wonderful, dark foreshadows that floated before the rising star of this important invention like indefinite shadows. Legend tells us that the Egyptian priests knew how to rejuvenate old age through blood. From them the sorceress Medea was instructed in this demonic art and she rejuvenated Jason's old father Aeson by draining his aged blood from incised neck vessels and infusing youthful blood into his veins. In his *Metamorphoses* Ovid puts the words in her mouth: 'Quid nunc dubitatis inertes? Stringite giadios veteremque haurite cruorem ut repleam vacuas juvenili sanguine venas.' It seems to me as if the traditions of the saga and the words of the poet that embellish them are based on that view, widely spread in antiquity, that the blood contains the actually invigorating force for the whole body, as if it were the soul.⁽¹⁾ From this, however, the view could easily arise that through an artificial resuscitation of aged blood the whole body could be given new strength at the same time.

In the historical period of antiquity there is no mention of an injection of blood into the veins of a person, and in the prevailing view of the movement of blood in the human body the idea of such an operation could not occur. According to the teaching of Aristotle, the heart prepares the blood in its own cavities, and through the branching veins it flows as a nutrient to all parts of the body and refreshes them, just as gardens are watered by streams of water that are continually branching. But the blood never flows back to the heart. The heart is at the same time the source of warmth for the whole body, furthermore the seat of the feeling soul, in short the most important organ, as it were the Acropolis of the body, which contains the impetus of its never-resting movements in itself. With blood flowing to all parts of the body it receives from the heart the faculty of feeling and moving. This force, the breath of life, flows to the heart with every breath through the windpipe and the lungs, and from the lungs it passes through the veins leading into the cavity of the heart, from where it goes on and on with the blood being poured into all parts of the body.⁽²⁾

The idea of transfusion was even less likely to be appreciated by the old doctors, since the peculiar assumption in the doctrine of blood movement has been generalized by the two famous scholars of the Alexandrian school, Herophilus from Chaleedon [Chalcedon] and Erasistratus from Keos [Ceos] (about 300 BC) it was accepted that the arteries only contain air that flows into them from the lungs when breathing.⁽³⁾

The reforms initiated by Claudius Galenus (131–201 A.D.) hardly brought it one step closer. Galen showed through experiment that the arteries contain blood: "arteria quacunq[ue] vuln[er]ata sanguinem egredi videmus ... Ubi funiculo dissectam arteriam utrimque ligavimus et quod in medio comprehensum fuerat incidimus, sanguine plenam ipsam monstravimus". The blood reaches the right heart through the arteries; here the warmth of the heart separates the usable parts of the blood from the useless parts. The unusable parts are carried through the pulmonary arteries into the lungs, through which they are excreted as soot (*fuligo*) on exhalation. The remaining usable parts of the blood pass through the holes in the septum into the left half of the heart. ('Quae in corde apparent foramina ad ipsius potissimum medium septum praedictae communicationis gratia exstiterunt.') Here in the left heart the invigorating force is imparted to the blood through the "pneuma" absorbed

into the lungs on inhalation, of which a small part can also flow through the holes in the septum to the venous blood.

Of the three fundamental errors which, as Flourens⁽⁴⁾ aptly says, kept the great fact of the circulation of the blood veiled, Galen removed the one that the arteries contained air, but two remained to be discovered, namely that the septum of the heart has holes through which the blood continuously flows from the right side into the left half of the heart, and finally that the blood flow in all veins has a centrifugal direction.

Vesalius resolved the second error by expressly saying: The substance of the septum of the heart is "so thick, compact and firm that he can never see how even the smallest amount of blood can get through the substance of this septum".⁽⁵⁾

It was therefore necessary to look for a new route which the blood had to traverse from the right to the left heart, and with the efforts of Michael Servetus, that unfortunate researcher who, at the instigation of the fanatic Calvin was publicly burned as a heretic in Geneva on October 27, 1553, succeeded in discovering the 'small cycle'.

In his book *Christianismi Restitutio* 1553 he says: "Fit autem communicatio haec (nämlich der Höhlen beider Herzhälften) non per parietem cordis medium, ut vulgo creditur, sed magno artificio a dextro cordis ventriculo, longo per pulmones ductu, agitur sanguis subtilis; a pulmonibus praeparatur, flavus efficitur et a vena arteriosa in arteriam venosam transfunditur."

Ten years later, the work of the selfish Realdo Columbo, the pupil and prosecutor of Vesalius, led to the same results, as did the investigations of the great defender of Aristotle, Andreas Caesalpinus, who first recorded the flow of blood "ex dextro cordis ventriculo per pulmones in sinistrum" proving "Circulatio".⁽⁶⁾

In order to make the idea of transfusion possible, the 'great cycle' had to be discovered. It was of the greatest importance to William Harvey that he was completing his medical studies in Padua (until 1604) when the famous anatomist Girolamo Fabrizio ab Aquapendente, Fallopius's [Falloppio's] pupil, had again drawn attention to the venous valves. He hadn't discovered how diverse it is, because around the middle of the 5th century AD, the same mentioned Theodoretus, bishop of the city of Cyrus in Syria in his 3rd talk about Providence states: "Venas tenuissimis tunicis vestivit (Deus) et orificiis carum exilia opercula addidit."

By examining mainly the veins, Harvey came to the elimination of the third fundamental error, which concealed the correct conception of the entire circulatory condition; he found the centripetal movement of the bloodstream in the veins, and thus discovered the complete circulation of the blood. That is what makes the discovery great, that it did not come about by chance, but according to a plan after logical deliberation and ingenious development. Harvey's compatriot and contemporary, Timotheus Clarek [Timothy Clarke] rightly says: 'Circulatio Harveyana, res nou casu, sed consilio inventa'.

Probably since 1616, but certainly since 1619, Harvey presented his new teaching in London⁽⁷⁾, but it was not until 1628 that he appeared before the public with his writing "Exercitatio anatomica de motu cordis et sanguinis in animalibus".⁽⁸⁾ The work is dedicated to his royal lord Charles I, who made him his personal physician, as well as to the College of Physicians in which he had so often shown his experiments.

The time was not far off when that civil war broke out in England (1642) in which the so often disappointed people wanted to defend their parliamentary rights by taking up arms against King Carl I [Charles I]. The king had to flee London and went to Oxford.

Harvey went with him and like the two universities of Old England, defended the king's cause. In Oxford, around this time of royal exile (1645), a society of wise men, with whom Harvey was also familiar, was formed, following the pattern of the learned societies of Italy, whose endeavors were directed through research and

experimentation to enrich the field of medicine and the natural sciences. The founding of this association was primarily inspired by Bishop Johann [John] Wilkins. It was called the "invisible" or "philosophical" college. When Oxford fell into the hands of the parliamentary troops under Oliver Cromwell and King Carl I [Charles I] was executed with the sword under the windows of his own banquet room in London, the 'society' went to London (1648), where the researchers stuck to their original aims.

When King Carl II [Charles II] came to the throne after the abolition of the interregnum, he, who was himself a fan of natural history, constituted the Society (1662), gave it privileges and rights, and gave it the name of the 'Royal Society', by which it is still known; and has exerted the most beneficial influence on the development of natural science and medicine, especially through its Philosophical Transactions, which appeared in 1666.

Blood transfusion originated from the womb of the College of Physicians and the Royal Society.

THE FIRST TRANSFUSION TRIALS IN ENGLAND

It is not surprising that the first attempts to carry out a transfusion were made in the country from which the discovery of the circulation originated. Harvey's discovery had caused a tremendous sensation in the entire medical world, and Albert von Haller [Albrecht von Haller] is certainly right when he claims: "novum inventum universam Europam medicam ad arma excitavit." So it was natural that precisely those men to whom Harvey had so often shown the flow of blood in living animals should endeavor to obtain new practical fruits from the physiological fact. At one of these demonstrations in the "invisible, philosophical" society, around 1638, the theologian Potter first suggested whether it might not be possible to replace the blood of one animal with that of another.⁽⁹⁾ This idea caused a stir in the Society, and a number of men were chosen to meet together to try and resolve this question. These were the brothers Daniel and Thomas Coxe, Wilkins, Hook and the famous physicist Robert Boyle.

In connection with transfusion, a second question of great practical value was suggested, namely infusion. It was justifiably asked whether it was not possible to inject various kinds of medicine directly into the veins and thus into the circulating blood, which until then had been absorbed almost exclusively from the digestive tract. It was precisely the internal connection between the two operations that made it possible for almost all researchers of that time to focus their studies on both transfusion and infusion. Dr Christopher Wren at the University of Oxford, later professor of astronomy and architect in London, first suggested the idea of infusion towards the end of 1656 and actually carried it out in Oxford. He shared his views with Wilkins and Robert Boyle.⁽¹⁰⁾ The apparatus he used consisted of a cannula, which was tied into the central end of an exposed and cut vein, and of a syringe bag that served to release the drug. Boyle in particular made sure that suitable instruments were made and also performed experiments on dogs himself. In one of these animals a solution of opium was infused into a vein of the hind foot, and after the anesthetic juice had been carried by the bloodstream to the brain, the dog was deeply anesthetized without dying. But another however, who had been given a strong solution of *Crocus metallorum* in the same way, passed away very quickly. Robert Boyle wrote the more detailed investigation in his work: *Usefulness of Experimental Philosophy* (Part. 2. Essay 2. 53-55).

Rumour of these attempts also reached the ears of the French ambassador de Bordeaux, who was residing in London, and who in 1657 with the assistance of Dr. Colladen, the Queen Mother's personal doctor, gave the first infusion to a human.

For the experiment they took a man, who was a minor servant of the ambassador and who had been sentenced to be hanged, and injected a solution of *Crocus metallorum* into his arm vein. However, during the infusion experiment the man had adverse side effects and therefore did not have a further infusion but he was however executed.⁽¹¹⁾

Since that time, however, experiments have been carried out on animals both in Oxford and in London before the Royal Society, chiefly by the general practitioner Dr. Timothy Clarke, who continued these interesting experiments with great care and tireless diligence.

As early as 1657, in which Oliver Cromwell was solemnly elevated to protector of England, T. Clarek [T. Clarke] had carried out both transfusion and infusion experiments⁽¹²⁾ and had reported and demonstrated them to the Royal Society before 1663. He had injected various drugs into living animals, even up to two pounds: emetics, cathartics, diuretics, cardiacs, and opiates. However, the success of all these infusion attempts had actually remained a dubious and inconsistent one, because as Clark [Clarke] himself says: "Agnosco tamen, me de hujusmodi experimentorum utilitate multum adhuc dubitare". But the results of his transfusions were more favorable, and especially those which he made by bleeding animals.

And here we find the highly important and clearly pronounced word of this knowledgeable experimenter: "Putem insuper, transfusionem sanguinis in magnis et subitaneis sanguinis profusionibus ad vires subito instaurandas fortasse multum posse conducere. Tumet nobiscum vidisti, vir amicissime" – so he goes on, calling Heinrich [Henry] Oldenburg, the editor of the *Philosophical Transactions*, as a witness – "animae large sanguinis profusione fere exangue redditum et convulsionibus lethalibus plane moribundum, sanguine alterius animalis, non ejusdem speciei, in illud transfuso, intra septem horae minuta ad pristinum et perfectum vigorem restitutum."

Clark's attempts even made an impression in the highest circles, and he carried out a cathartic infusion into the vein of an animal in the royal palace in the presence of Count Palatine Ruprecht. Around this time another scholar Dr. Henshaw was also studying how to perform a transfusion.

Nevertheless, considerable difficulties were still associated with it; until in 1666 the famous London anatomist Richard Lower gradually devised a practical method and carried out a transfusion with good success, first in Oxford, then also in London with the Royal Society of Physicians at a public meeting in Gresham Colledge [Gresham College].⁽¹³⁾ Robert Boyle took an active part in these experiments.

Robert Boyle, born into the old English family of Corke [Cork], a weak, delicately built man by nature, had ardently devoted himself to the study of medicine and the natural sciences. He also showed that trait of the true kind hearted, that he himself prepared medicines in his laboratory and distributed them to the poor who were sick. His name is also immortally linked to a number of the most important discoveries in the field of natural science and medicine.

This researcher now tells us the method by which Richard Lower made his first transfusion attempts in an essay: The method observed in transfusing the blood out of one animal into another.⁽¹⁴⁾ Two dogs are tied up next to each other, lying on their backs, for one of them a long length of the common carotid artery is exposed, cut through, and the peripheral end closed with a ligature, and a cannula is tied into the central end. A provisionally tied knot around the vessel inhibits the outflow of blood from the cannula. In the second dog, the external jugular vein on the adjacent side of the neck is exposed and opened. The carotid of the blood-donating dog is then inserted into the central end of the vein of the cannula. Blood can be dispensed at will from the peripheral end of the vein of the recipient. The provisional knot on the carotid is now loosened, and blood flows freely into the vein of the other animal. To the extent that arterial blood flows in, blood of the receiving dog is allowed to drain from the peripheral vein end.

In these experiments, however, some precautionary measures must be observed. First of all, the joined vessels must not be pulled, because this can easily impair free circulation. Care must also be taken that the pulse of the blood donor, propagated from the carotid, can also be felt in the central jugular end. If the pulse is absent, one can assume that the cannula has become blocked by a clot, which must then be removed.

Boyle also believes that it is best to take dogs of the same age, which are possibly fed at the same time and in the same way, so that blood that is used for exchange is as similar as possible. When the inflow is complete, the vein is tied twice and the neck wound is joined by sutures. (The dog that gave the blood is not taken into account.) Another interesting story is that after the surgical procedure described, the blood of a very large dog was gradually chased through the veins of a small dog until the large one had bled to death. When the little one was then unleashed, he jumped nimbly from the table and shook himself as dogs do when they fall into the water; and he was well.

These experiments had not only been carried out on dogs, but also on hares; indeed, the blood of a hare has even been successfully passed into the veins of a dog.

In connection with these interesting experiments, Boyle now opens up the prospect that all possible modifications should be made to the transfusion of animals: the blood should be exchanged between old and young animals, between sick and healthy, warm-blooded and cold-blooded, timid and fearful, tame and wild, etc. In addition, so that one can also be certain that an animal has received new blood throughout its body several other animals can be bled out in the same row one after the other.

How thoroughly the researcher dealt with the whole question of transfusion and how versatile he understood it is identified in an account⁽¹⁵⁾ in which Robert Boyle raised a whole series of questions about the exchange of blood which are certainly worth reporting in the highest measure.

These are the problems:

1. If one observes a change in the natural disposition of the test animal during a complete exchange of blood, such as a wild dog is tamed by taking the blood of a tame dog?
2. Will a transfused dog recognize its master; will he practice the same habits better or worse?
3. Can one see the peculiar characters of a dog change after repeated transfusions of blood from another type of dog?
4. Whether a dog the learned habits of a dog will be maintained; will he fetch, dive for ducks, etc?
5. Will a change in pulse, urine, excrement and perspiration be perceptible in a dog whose blood has been exchanged?
6. Will a hungry dog lose its appetite if it is injected with chyle-rich blood from another dog?
7. Will he be able to be kept alive only by the injection of chyle taken from the receptaculum chyli of another?
8. Will a dog suffering from a blood disease be cured if its blood is replaced with healthy blood?
9. If an old dog receives blood from a young one, does it become youthful again, and vice versa, will a young one become old with blood from old dogs?
10. Can a young small type of dog get bigger by giving it blood from a young large type dog?
11. Is it possible to mix medicaments together with the transfused blood - and is the effect of the medicaments thus given different than when they are given by mouth?

12. Does the injected blood from a dog that has been given a purge also have a purging effect on the dog to which it has been given?
13. What are the effects of a transfusion of blood between different species / genera, even between cold-blooded animals (fish, turtle) and warm-blooded animals?
14. Will the colour of the hair or feathers change when one chooses animals of different colors for blood exchange?
15. If the substitution is repeated in different dog races, will one be able to notice a gradual conversion of the races?
16. What effect does the transfusion have in pregnant animals in relation to the young, especially if the blood exchange is carried out at various stages of pregnancy?

Robert Boyle, as one can see from many of his communications, understood transfusion as the most complete possible exchange of blood; in the experiments, the blood donating animal usually died of bleeding after anemic convulsions.

The commission chosen by the Royal Society to examine transfusion continually suggested new experiments with the greatest zeal. Primarily favorable results have been achieved with blood transfers after heavy blood loss – one made a sheep bleed to death into another with favorable results. Thomas Coxe⁽¹⁶⁾ diverted 14-16 ounces of blood from a scabies dog into a healthy one. The consequence of this was that the healthy one remained healthy, but the sick one quickly wasted as a result of the profuse depletion. It is reported by the same researcher⁽¹⁷⁾ that he bled a pigeon to death and then brought it back to life through the blood of another. Here we should also mention Lower's interesting experiment, which caused the carotid blood of a dog to run into the jugular vein of the same animal.

On the whole, less successful results were obtained when using blood of different kinds. It is true that Edmund King⁽¹⁸⁾ transfused [blood] from a calf into a sheep with great success, but not so well was a sheep that was given blood from a dog and a dog to which King had given sheep's blood. In particular it turned out that foreign blood that was given too abundantly could harm the life of the recipient, and so a fox given lamb's blood suffered greatly and died.

But the climax of transfusion in England was by Richard Lower, because it was this famous London anatomist who, on November 23, 1667, together with Dr. Edmund King who performed the operation on a human, the first in England.⁽¹⁹⁾ Before that, on June 15 of the same year, Denis had performed the first human transfusion in Paris.

The operation was carried out in London on a 22-year-old baccalaureate in theology by the name of Arthur Coga in the presence of many distinguished people in Arundel [Arundel] House. The patient suffered from mental confusion, it is said of him, "his brain was him a little too warm"; Lower calls him "hominem amabili vesania affectum". Before the operation he was sectarian and during the operation he smoked and drank vermouth. At first a vein was exposed in the patient's arm, and 6 to 7 ounces of blood were withdrawn from it, as in a bloodletting process. A long silver tube was then tied into the central end of a freely dissected carotid artery of a young lamb. The cannula was then inserted into the vein wound of the arm and 9-10 ounces of carotid blood were allowed to flow freely into the man's vein towards the heart, so that even the pulsations of the throat veins could be seen through the long tube and felt in the arm vein beyond it. The patient found himself during and after the operation "very well", highly praised the procedure and loved to talk about it with praise.

When asked why he had had lamb's blood poured into him he said, "quia sanguis agni habet symbolicam quandam facultatem cum sanguine Christi". ["Because the blood of the lamb has a symbolic capacity with the blood of Christ"] The patient wished that the operation should be repeated after only 3-4 days, but they only consented to the requests after a few weeks, in that 8 ounces of blood were drained

and 14 ounces of lamb's blood was given to him in the same way. A slight fever followed this procedure.

Neither transfusion, however, appears to have exerted any benevolent or sedative influence on his mental state, for it must in any case appear alarming that the man, proud of the new heroic operation carried out on him, has since been called the martyr of Philosophical Society in London. In addition, Hamel and Dr Blondel [Blundell], who came to see him in London two years later, found him just as crazy as he was before the operation.

Of further transfusion attempts that were suggested by the Philosophical Society, was one by Dr. Cronne [Croune]⁽²⁰⁾ who suggested that the liver of a hungry dog could be maintained by repeated transfusions; but the experiment itself was not carried out.

This attempt, he says, would decide whether the blood feeds or not; it could also be changed so that only the blood-bearing dog is allowed to breath and the blood-receiving animal cannot breath itself, in order to see whether it can survive merely through the respiration of the other.⁽²¹⁾

THE FIRST TRANSFUSION TRIALS IN FRANCE

While in England we see almost all learned physicians working in a united effort to raise transfusion and infusion to the level of a physiologically tested, rational operation, in France we only meet one who fights for the new healing method, fights against the majority of physicians and naturalistic scholars. It is Jean Baptiste Denis, professor of philosophy and mathematics at the Royal University of Paris. And although he has not been able to get transfusion accepted and recognized among doctors, and even though on the occasion of his operations the royal government even restricted the free execution of the operation by public decree, the fame of Denis remains, the first transfusion to have done to a person that was ever carried out.

The reason why transfusion found so many opponents in France is to be sought in the guiding principles of medicine as a whole, which were then spread from Paris.

In the 'Academie des Sciences' founded by Cardinal Richelieu, the leading voice for medicine was the ingenious Gui Patin. He had broken with the Arabs and turned again with all zeal to the study of the ancients – the writings of the masters of ancient medicine: Hippocrates, Aristotle, Galenus. They turned their backs on the impulses and aspirations of a new epoch, which began to shine with the discovery of the circulation in England. In Paris they were reactionary, while in London everyone took up the new physiological-empirical direction with zeal. Gui Patin rejected the syrups and opiates of the Arabs, but he also rejected the cinchona bark, which time had taught us to know, he rejected tea, the "impertinent nouveauté de siècle" ["sassy newcomer of the century"] he finally also rejected the new doctrine of the circulation, against which his college Riolan in Paris had fought so desperately.⁽²²⁾

Gui Patin's remedies were bloodletting and senna. He bled children and old people with an illness 32 times each, he bled himself 7 times because of rheumatism; even babies as young as 3 days were not spared. "We are curing many more sick people with a good lancet and a pound of senna, which the Arabs cannot do with all their syrups and opiates", he writes in his letters.⁽²³⁾

With such guiding principles it was all too clear that Denis could not establish the general validity of transfusion, the true antithesis of bloodletting Gui Patin and his comrades were victorious and a vampyrism was practiced under the hands of these "Grands-Saigneurs" that Leonardo Botallo, Marcus and Broussais hardly ever practiced.

There is darkness over the first beginnings of transfusion in France; in any case, they were insignificant and of doubtful worth. Nonetheless, they wanted to take priority for themselves. French journals reported that a Benedictine Friar, or, according to others, a Don Robert de Gabets, first proposed the transfusion to Mr. de Monmors [Montmor] around 1658.

Viewed only in the light of day,⁽²⁴⁾ the French reports do not date until March 1667, while the Royal Society in London asked for a transfusion in its public session on May 17, 1665 (following Wren's suggestion for infusion)⁽²⁵⁾ and that well-known transfusion committee had appointed. Moreover, it is certain that Richard Lower had already published his method, which has proven itself on animals, in December 1666.

The really classic age of transfusion in France begins with Denis, who made his first experiments on animals.⁽²⁶⁾ He let 3 dogs bleed to death and then let calf blood flow into their veins and they were supposedly well afterwards; one of these, who the day before had been very weak from severe loss of blood, showed a considerable increase in strength after the operation. These experiments were repeated on 19 dogs and a few calves; all of them survived the operation well and had no secondary illnesses. Denis transfused sometimes from vein to vein, sometimes from artery to vein.

Having prepared enough experiments, Denis decided, with the assistance of the surgeon Emmeriz [Emmery], to do the first transfusion on a human.⁽²⁷⁾

He was a febrile fifteen to sixteen year old, whom doctors had done 20 great bloodlettings in a short time in order to withdraw the fever-heated blood, entirely in the manner of Gui Patin. As a result of this drastic treatment there had been a very significant decline in strength; exquisite anemia, great exhaustion, apathy, loss of memory and such a great somnolence that Denis found the patient asleep even at breakfast. Denis, on the assumption that the great loss of blood had undermined the patient's constitution, and that the little blood still affected by the fever harmed the body, planned a transfusion.

It was 5 a.m. on June 15, 1667, when Denis and his assistant Emmeriz [Emmery] performed the transfusion. About 3 ounces of venous blood was drained from the patient beforehand, which Denis considered to be particularly spoiled due to its dark color and thickness, and about 9 ounces of blood flowed directly into the arm vein from the carotid artery of a lamb through a tube.

'Then bandage like after bloodletting and a quiet bed'. The patient stated that he noticed heat in the vein on his arm during the operation. At ten o'clock he could no longer be kept in bed, he got up, was thoroughly lively, ate and drank, and was in a friendly and cheerful mood.

At 4 o'clock in the afternoon there was a slight epistaxis of only a few drops; at 9 o'clock in the evening he went to bed and slept well; he woke up again at 2 a.m. and got up from his bed at 4 a.m. The patient showed a much greater vivacity than before, the somnolence had disappeared, the mental powers increased, he became strong and aroused general astonishment among all who knew him.

The indications according to which Denis considered the transfusion necessary in this case deserve full recognition. But it is a mistake that Denis considered animal blood to be the most excellent for human transfusion because, as he believed, animals would not have spoiled their blood either through excess or through passions, because furthermore their blood could be prepared beforehand by feeding and because the flesh of the mammals also serves as food for man.

It is also erroneous to believe that the success of his cure is due to fermentation and the resulting development of spirits.

No matter – encouraged by the first lucky success, soon afterwards Denis performed the operation on a second man. This time it was more of an experiment than a real cure. The individual in question who presented himself to be operated on was a Paris litter-bearer of about 45 years of age, to whom Denis had offered a good

deal of money if he agreed to have a transfusion. Since the man was healthy and showed no notable indisposition to the operation, he decided to undertake a copious transfusion. Denis and his assistant Emmeriz [Emmery] first let ten ounces of blood flow from the vein in the man's arm, and then allowed another twenty ounces to flow directly from the crural artery of a lamb through a tube to the patient, executed in just the same way as the first successfully treated one. During the operation, the man kept his jovial sense of humour about this strange operation and was amazed when the sheep was brought closer to his arms. He also mentioned the feeling of heat on the arm while the arterial blood was flowing through it. Afterwards the patient was advised to lie in a quiet bed; however curious he immediately cut up the lamb, whose blood he had been given, and went home. On the way, in the first decent inn, he met with some friends with whom he spent the money he had received from Denis. All this did not disturb the favorable outcome; his condition being more than excellent. The next morning Denis found the man wandering around in the streets of Paris again, and when Denis rebuked him for his carelessness, he replied that he was well in every respect, that he could not stay in bed because of that, and if Denis wanted to repeat the operation he would have it again.⁽²⁸⁾

The happy successes which Denis had achieved aroused a large group of adversaries and envious people in Paris, who all endeavored to suspect transfusion and to suppress it again.

The most important of these were Guillaume [Guillame] Lamy, Magister Artium [M.A.], and the Abbé Pierre Joseph Michon Bourdelot. The latter, doctor and clergyman at the same time, was considered an influential man⁽²⁹⁾; for a while he had been Queen Christine's personal physician. He loved to gather famous men in his home for scientific meetings, which he presided over.⁽³⁰⁾ The reasons this man argued against transfusion were admittedly of the weakest kind – a child had died because the midwife had smeared the blood in the umbilical cord into the body cavity after the birth – and therefore transfused blood must be just as harmful. Lamy too had little argument against transfusion other than wit and scholastic subtlety.⁽³¹⁾

The only part of his arguments that is noteworthy is that he maintains that the difference in blood of various species of animals is dangerous, and that the introduction of excessive amounts of blood is disadvantageous for the operated persons.

Besides these, Gayant, Perrault,⁽³²⁾ and Pequet, the discoverer of the thoracic duct, also argued against transfusion, in part basing their opposition on unfortunate experiments on animals.⁽³³⁾

They were joined by Pierre Martin de la Martiniere⁽³⁴⁾ and Pierre Petite⁽³⁵⁾, the latter fully advocating the point of view of Gui Patin and the Parisian therapists, trying to prove that the treatment of diseases requires bleeding but not the transfusion of blood. Finally we want to mention the objections of Gaspar de Gurye de Montpoly⁽³⁶⁾, whose opposition is also not supported by experimental investigations. For theoretical reasons, he believes that during a transfusion, the coming together of two different types of blood in the same body must be dangerous. He further assumes that if too much foreign blood is injected, the life of the indwelling blood will be overcome, thereby threatening to cause the recipient's death. It is therefore favorable if haematuria and epistaxis occur in transfusion, because the injected excess is excreted and the danger to life is reduced. J.B. Denis had little support against this mass opposition. Gadroys⁽³⁷⁾ replied to the enemies of transfusion that foreign blood is by no means hostile in a body, since one can also see how a foreign twig grafted onto a trunk flourishes and bears fruit.

Denis was also supported by Tardy⁽³⁸⁾, Professor of Surgery, who suggested venous blood transfer from person to person. Given the multiple adversities that resulted from the many disputes with his opponents, Denis remained true to his plan to carry out transfusions on humans as often as the opportunity and indications presented themselves. His cure aroused great excitement in Paris when he

performed it on Baron Bond, the son of the first Minister of State of the King of Sweden.⁽³⁹⁾

The patient had been suffering from feverish diarrhoea for three weeks, and had been treated by four doctors according to the school of that time with blood-letting, purgants, and enema to the greatest exhaustive degree. So that nothing was left untried, Denis was finally brought in for a consultation. But only after all the attending physicians had given the written agreement that the patient would surely die in a few hours without further treatment did Denis and his assistant Emmeriz [Emmery] agree to a transfusion. The patient was already unconscious and cramped in agony. The dying person was given six ounces of arterial calf blood according to the earlier method, whereupon there was immediate undoubted improvement: consciousness returned, the spasms subsided, the pulse rose, and the patient appeared visibly gaunt. The operation was repeated the following morning, but the patient died that same day. The autopsy showed most of the organs of the abdomen in such a pathologically degenerate state that death must be inevitable under all circumstances. The heart was bloodless. Furthermore, Denis managed to cure a woman who was paralyzed on one side by infusing sheep blood.

The next case, of the treatment of a mentally ill person by transfusion, had a decisive influence on the fate of the transfusion in France.⁽⁴⁰⁾

The valet Ant. [Antoine] Mauroy, 34 years old, had fallen into a violent madness, which returned from time to time, as a result of an unhappy love affair 7 or 8 years ago. Whilst free of his madness, he married a young lady and lived in a place twelve miles from Paris. But suddenly, after 4 months, the old disease broke out again; the afflicted tore his clothes from his body and, otherwise ignorant of this, ran to Paris in the dark of night. His wife looked for him in vain in all the surrounding villages. In Paris the unfortunate man wandered around without shelter because people were afraid that he would infect their houses. Then Mr. de Montmors [Montmor] finally took pity on him, let him be admitted and at the same time suggested a transfusion to Denis and Emmeriz [Emmery]. Perhaps, through its mildness and freshness, calf's blood could soothe his mental functions. The madman was taken to a private house and the well-known paid litter-bearer, to whom Denis had previously given a transfusion, was appointed as a guard; and to persuade him as best he could. On December 19, 1667, at 6 o'clock in the morning, the operation was performed in the presence of many respected physicians. The patient was first drained ten ounces of blood, and then five or six ounces from the crural artery of a calf flowed back into his arm vein. There was calmness and improvement. In order to restore the patient completely, a second operation was proposed, to which his wife, who had meanwhile found him again, agreed. This second operation was performed on the Wednesday before Christmas in the presence of the physicians Bourdelot, Lallier, Dodar, de Bourges, Vaillant and others.

This time a large amount of blood was allowed to flow in. During the operation the patient felt a sensation of heat on the arm in the course of the arterial blood flow in his veins, after which the patient complained of pain in the kidney region, and moreover there were signs of oppression on the chest and irregularities in the heart. On Saturday, the last day before the Christmas Eve, there was a nosebleed and the discharge of a dark sanguineous urine. Nevertheless, the improvement of the sick man was unmistakable; he asked for the sacraments, was happy to see his wife again and thanked Mr. de Montmors [Montmor] for his kindness and that he had saved him from his deep misery. He was healthy and well, and the case attracted general attention in Paris.

This striking and brilliant success set a whole host of envious people in motion; some claimed that the patient had become even crazier after the transfusion than he had been before, whilst others even said that he had died at the hands of the surgeons. The man's condition lasted for two full months, but after that the illness, probably aided by a dissolute life, reappeared in its old form. The wife of the

unfortunate man insisted Denis and Emmeriz [Emmery] perform a transfusion again. They agreed.

With the carotid artery of the calf already dissected, the patient was first prepared so as to withdraw blood from the veins of the arm and leg. But since this did not succeed, the operation was declined, all the more so because in the mere attempt to insert the cannula into the patient's arm vein, the patient made the most violent convulsive movements.⁽⁴¹⁾

According to Martin de la Martinière, Denis's opponent, the two surgeons had actually performed the transfusion. But no sooner had they started to run blood into their veins than Mauroy began to scream: 'Hold on, I'm dying, I'm suffocating' - (This statement has since been shown to apparently agree with the statements of the internal surgeons) - The transfusionists continued the operation and advised him: 'my friend, you haven't had enough' and so he died in their hands. cf. Scheel l. c. p.150-151.

The following night - but not during the operation - the patient died, probably from poison that the woman [his wife] had given the patient. The section [this word implies an 'autopsy'] that Denis insisted on was refused. When the funeral was over, three doctors, envious of Denis, asked the woman to testify that her husband had died during the third transfusion, and they bribed false witnesses to give the same testimony.

Indeed, their cheek went so far as to provoke the woman to sue Denis to keep her for the rest of her life for having put her husband to death. In the face of such intrigues, however, Denis considered it more advisable to break his long-observed silence and to accuse both the wife of the deceased and the three doctors for their shameful defamation. The judicial investigation found that Denis and Emmeriz [Emmery] had cured Ant. [Antoine] Mauroy from his madness twice with the transfusions and that the healing had lasted two full months after the second operation. From that time on the man gave himself up to all excesses, his wife supported his passions, but secretly gave him arsenic. It is certain that she mixed a powder into some bread, which was not eaten by her or strangers, but a cat, who later ate the bread, died. The woman also issued death threats against her husband. The transfusion was probably intended the third time, but it was not carried out because no blood would drain from the patient's veins. The patient did not die until the following night.

The woman prevented the section [this word again possibly implies an 'autopsy'] because she stated that her husband was already in the coffin, which was not true. The woman also testified in court that the three doctors had made promises and pledged money to her when she said that her husband had died during the transfusion; a witness testified that one of the doctors had offered him twelve louis d'or if he would make the same false statement. The court decided to hold the woman and the three doctors personally accountable, but at the same time it issued the heavy edict that no transfusion should be performed on humans in the future unless the doctors of the Paris faculty had given their consent. That was decisive for the fate of transfusion in France. Denis could never count on approval for his favorite operation, for the faculty was run by his opponents, Bourdelot and comrades. Thus in Paris transfusion was suppressed by intrigues and coterie. It was only with anger that Denis turned away from the dishonest behavior of his opponents; but what use was it to him to plead for himself and his operation with the faculties at Rheims and Montpellier; in vain, his hands were tied.

In spite of this, transfusion remained a favorite operation for him, and carried out on animals for a long time.⁽⁴²⁾ This is how the transfusion trials in France, which had started so promisingly, ended.

It must at least appear striking why transfusion in England was not carried out on a person earlier than in France, since it had been known there for much longer and had been tested much more thoroughly on animals.

But in England the laws concerning dangerous cures were then much stricter than in France. We also know that at the beginning of 1667, Dr. Edmund King in London already had everything ready for a human transfusion.⁽⁴³⁾ But chance did not lead him to a suitable case and so it happened that Denis preceded him in performing it.

THE FIRST TRANSFUSION ATTEMPTS IN ITALY, GERMANY AND HOLLAND

At the time when transfusion was practiced in England and France, following the discovery of the circulatory system, the star of the Italian school, which previously shone so splendidly, was already pale. So it happened that the new operation found imitators here, but no one who would have fully understood and appreciated its scope. Here, too, we often see transfusion and infusion being treated together. It is strange that even before the circulatory system was discovered, there was a man in Italy who had already hinted at the transfusion of blood – he is Johannes Colle, Professor in Padua. In his *Methodus parandi tuta et nova medicamenta*. Venice 1628, he says: “. . . Veluti si quis sanguis e vena exsiliens juvenis admodum salubris, per fistulam in venam senis permeet ... ut sanguis juvenis intus attrahatur a sene et ne hujus egrediatur.” Franciscus [Francesco] Folli also boasts⁽⁴⁴⁾ that he considered the possibility of transfusion as early as 1652. While Carolus Fracassati, Malpighi's friend, continued to occupy himself with infusion experiments, Dominicus Cassini (1667) made a complete substitution of the blood of one lamb by the blood of another lamb with very good results. Another attempt was made in Udine in Signor Griffoni's house, by letting the blood of a lamb flow into a thirteen-year-old dog who had been deaf for three years and which is said to have regained its hearing.⁽⁴⁵⁾ Also worth mentioning are those experiments which Ippolitus Magnani made in Rome in 1667 and 1668. He rescued five different dogs that he had exposed to death by bleeding by giving them dog's blood. On the other hand, three other dogs which he treated with lamb's blood, blood urine was observed, one of them had considerable rumbling in the intestines as a result of the lamb blood transfusion and all the animals died.

The above mentioned successful animal experiments gave Joh. Guilelmus Riva, doctor of Pope Clement IX confidence to perform the first human transfusions with lamb's blood in Rome in 1667. He inserted the transfusion cannula into a somewhat large bloodletting wound, and so he succeeded in the operation: “non bestiali more, sed facilliori et humana methodo prosperoque eventu, ... sine venae extractione vel excoriatione, sed solo congruo ac consueto phlebotomico, aliquantulum ampliori licet orificio.”⁽⁴⁶⁾ The operation was carried out on a total of three people, first on a consumptive man who received only a few drops of lamb's blood and did not get better, then on a febrile patient who was temporarily banished from the fever, and finally on a third patient who was probably healed. When prompted by a Belgian named Camay, Paulus Manfredi first performed a lamb blood transfusion on dogs and then also on humans, with a positive outcome.⁽⁴⁷⁾ Michaelus Lipari from Messina, a violent man who was agitated by religious relatives and who later lost his life for participating in a rebellion, attempted transfusions on animals.⁽⁴⁸⁾

In his writing: *Contusio transtusionis, sive refutatio nperationis transfundentis sanguinem de individuo ad individuum*, Bartholomaeus Santinelli campaigned against transfusion. Rome 1678. He refers to the above-mentioned unfortunate experiments which Ippolitus Magnani had carried out on animals and calls out the indignant word with Seneea (while he speaks of the gladiatorial games): “Homo, res sacra, jam per lusum et jocum oceiditur!”. These and similar hostilities finally led to the fact that the transfusion of human was also banned in Rome.

Germany can boast that many years before the discovery of the circulatory system, one of its scholars made the first undoubted suggestion about the transfusion of blood. Andreas Libavius from Halle, director of the grammar school in Coburg, chemist and doctor, says in his writing: *Defensio Syntagmatis Areamorum chymicorum contra Henningum Scheunemannum* (actione 2. pg. 8) Editio Francof. A. 1615.(49) - "Adsit juvenis robustus, sanus, sanguine spirituosus plenus: Adest exhaustus viribus, tenuis, macilentus, vix animam trahens. Magister artis habeat tubulos argenteos inter se congruentes, aperiat arteriam robusti et tubulum inserat munitaque: mox et aegroti arteriam findat et tubulum femineum infingat. Iam duos tubulos sibi mutuo applicet et ex sano sanguis arterialis ealens et spirituosus saliet in aegrotum, unaque vitae fontem affert, omnemque languorem pellet."

The experiments which are carried out in Germany via transfusion are, by the way, possibly of even less importance than those of the Italian experimenters. But consider that Germany hardly began to recover from the nameless misery that the Thirty Years' War had poured out on it, and that at the beginning of the 17th century - which was at least significant - there were no anatomical chairs at all from which suggestion and instruction could have taken place. In 1664, when the investigations that caused such a sensation in England became known, Joh. [Johann] Daniel Major, professor of medicine in Kiel, proposed the infusion of drugs and at the same time discussed the transfusion of blood, which he called "transplationem novam" but he also warns against it.

Balthasar Kaufmann from Küstrin was the first to come to Frankfurt and operate on humans. He repeatedly allowed lamb's blood to flow into the arm veins of a man suffering from leprosy and thus healed him; one fisherman who suffered from an eating rash did not get better after the transfusion, in fact it got worse. Even with two seorbut soldiers who were treated in the same way, the success must not have been a brilliant one. Purmann, who had assisted in the operation, remarked that the two people had barely recovered from their sheep melanism in years.⁽⁵⁰⁾

Sigismund Elsholz, personal physician to the Elector of Brandenburg, emerged from the Italian school, a good botanist and anatomist, but primarily known as an infusor through his *Clysmiatria nova, addita inaudita sanguinis transfusione*, Col. ad Spream 1667, raised the strange question of whether one could naturally reconcile disunited spouses and siblings through repeated mutual exchange of blood. Michael Crügener, on the other hand, evenly rejects transfusion and infusion, without being able to refer to independent attempts. Michael Etmüller, professor in Leipzig, from the school of van Helmont and Sylvius, who was one of the most famous doctors of his time despite his untimely death at the age of 39, generally disapproves of transfusion⁽⁵¹⁾: it is not able to rejuvenate life; perhaps help could be expected from it after severe loss of blood and in melancholy conditions.

In Holland, too, transfusion caused a stir for a while. We know that Regnier de Graaf made some animal experiments around 1668, almost at the same time as did van Horne. But no new and important results were obtained in these experiments, neither was the operation dared to be carried out on humans.

At this point I must also mention that some researchers suggest that there are still indications of transfusion, some from very early times. However, a close examination shows that this information must be taken with great care. First of all, the Platonist Marsilius Ficinus from Florence, who lived towards the end of the 15th century, is mentioned. I have searched the works of this man (M. Ficini opera. Basiliae) and only find (Tom. I. pag. 518) that in the chapter 'de usn lactis sanguisque humani pro vita senum' he suggests that old people could be rejuvenated by sucking blood from a youth's arm vein.⁽⁵²⁾ And he concludes: Nee forte diffidas juvenilem sanguinem a sene bibitum trahi ad venas membraque posse, ibique prodesse quam plurimam. He also remarks that the young man's blood could be prepared beforehand, before the old man drinks it. This last remark leads me to the second communication. According to the testimonies of Villari and Sismondi, in Italy, in the 15th century,

Pope Innocent VIII, who was suffering from great weakness, was also given a transfusion of boy's blood by a Jewish doctor. Only the annals of Raynaldus, the original source of this information, speak of the fact that the Jew: ...*"Sanjuinem exhausserit, ut ex eo pharmacum stillatitium chimica arte paratum propinandum Pontifici conficeret."* Finally, Martin de la Martiniere gives further traces of the transfusion in his book cited above, which I unfortunately could not get from the library in Berlin and Gottingen for reference. He finds it hinted at:

- 1) In the blood baths of the ancient Egyptian kings
- 2) In the Book of Wisdom of Tanaquil the wife of Tarquinius, where it is said that she practiced it [Transfusion]
- 3) In the anatomical traditions of Herophilus
- 4) In an old Jewish author Ben Israel Manasseh, Rabbi in Amsterdam, which was shown to him, in which it is said in clear words: Naam, a prince from the army of the Syrian King Ben-Adrad, who was to be cured of the leprosy, had blood drawn from his veins and new blood returned into his veins
- 5) In the holy book the priest Apollos
- 6) In the investigations of the Eubages
- 7) In Pliny, Celsus
- 8) In Ovids' Metamorphoses
- 9) In the Principles of Physics by Maximus
- 10) In the Treaty on the sacrifices of the emperor Julianus, by Libavius, who speaks of them [transfusions] as having been an eyewitness
- 11) With Marsilius Ficinus, with Abbot Trithemius, Aquapendente, Harvey, Fra Paolo, (cf. Scheel. I. e. 159) – It seems to me to be worth the effort to investigate these details although some of them may prove to be incorrect.

References

1. Vgl. v. Bähr, Symbolik. II. 247.
2. De part. anim. II, III, IV – de respir. 20, 21 – de generat. anim. II. 6 – de juven. et sen. III.
3. cf. Galeni de utilitate respirationis. Edit. Junta. Venet 1597. p.223 ... “arteriarum expletionis gratia respiramus velut Erasistratus putat?”
4. Histoire de la découvrir. de la circulat. du sang. Paris 1857. p. 14.
5. Andreae Vesalii, Opera omn. anatomic. Edit. Albin. 1725. T. I. p. 519.
6. And. Caesalpini, Quaest. peripat. Venet. 1593. Lib. V. p.125.
7. Taylor, Orat Harv. 1756.
8. Francofurti 1628. 4^o. pp. 72.
9. Philosophical transactions. 1668. 18 May.
10. An account of the rise and attempts of a way to convey liquors immediately into the mass of blood. Philos. Transact, Vol 1. 1665. Nr 7, p. 128. 4 December
11. cf. Philosophical transactions. 1665 and 1668.
12. A letter etc. by Dr. T. Clark concerning some anatomical inventions and observations particularly the origin of the Injection into veins, the Transfusion of Blood. Philos. transact. 1668. 18 May.
13. The success of the Experiment of transfusing the Blood of one animal into another. Philos. Transact. Vol. 1. 1666. No.19. p.352. 19 November.
14. Philosoph. Transact. Vol.1. p.353. 17 December 1666.
15. Tryals proposed by Mr. Boyle to Dr. Lower to be made by him, for the improvement of Transfusing Blood of one living animal into another. Philos. Transact. Vol.1. p.385. 16. Febr. 1666.
16. An account of another Experiment of Transfusion. Philos. transactions. 1667. Nr. 25. p.451
17. Birch, History of the Royal philos. Society 1757.
18. An account of an easier and safer way of transfusing Blood etc. Philos. transact. 1667. Nr. 25. p.449
19. An account of the Experiment of Transfusion practiced upon a Man in London by Richard Lower and Dr. Edmund King. Philos. transact. 1667. 9. Dec. Nr. 30
20. Birch I. c. p.356
21. P. Scheel. Die Transfusion des Blutes und Einsprützung der Arzneien in die Adern. Copenhagen 1862. I. p.181-182
22. Opuscula anatomic. Nov. Paris 1649.
23. Lettres de Gui-Patin. Tom. I. p 400
24. Philos. transact. 18 Mai 1668
25. Philos. transact. 21 Oct. 1667. Nr. 28
26. Journal des Savans. Mars 1667. cf An extract of a Letter of M. Denis, touching the transfusion of Blood of April 2 1667. Philos. trans. Mai 6 1667 Nr. 25 p.453
27. A Letter concerning a new way of Curing sundry diseases by transfusion of Blood etc. by J. Denis at Paris. June 25. 1667. Philosoph, transact. 1667. Nr. 27. Monday July 22.
28. Philosop. Transactions 1667. Nr 27 - Dessgleichen: Lettre à M. de Montmort, touchant deux experiencies de la transfusion faites sur les homes. Paris 1667. Journal des Savans. p. 44, 65.
29. cf. Haller's Bibliotheca med. pract. Tom. III.
30. cf. Conversations de l'academie de M. l'Abbe Bourdelot recueillies par le S. Gallois. Paris 1675.
31. Guilielmi Lamy, Lettre à M. Moreau contre les prétendues utilités de la transfusion du sang. Paris 1668. Seconde lettre de M. Lamy pour confirmer les raisons qu'il a apportées dans sa première lettre contre la transfusion du sang. Paris 1668. Wahrscheinlich von Moreau selbst.
32. Claude Perrault, Ess. de physiol. Tom. IV.
33. cf. Haller, Biblioth. med. pract. III p. 547.
34. Opuscules contre les circulateurs et transfusions du sang. Paris 1668.
35. Pseudonym: Eutyphrontis de nova curandorum morborum ratione per transfusionem sanguinis. Paris 1668.
36. Lettre de M. Gurye de Montpoly à M. Bourdelot sur la trausfus. du sang. Paris 1668. — cf. An account of more Tryals of Transfusion, accompanied with some considerations, cet. Phil, trans. October 21. 1667. Nr. 28.

37. Lettre de M. Gadroys a M. Abbé Bourdelot pour servir de reponse à letter écrite par M Lamy contre la transfusion. Paris 1668.
38. Traité de l'écoulement du sang d'un homme dans les veines d'un autre. Paris 1667. Avril.
39. cf. Philos. transact. 1667 Nr 28 und p.562.
40. Lettre sur une Folie invetérée guérie par la transfusion. Paris. Journ. des Savans 1667 — an extract of a letter etc. touching a late cure of an inveterate Phrensy by the Transfusion of Blood. Philos, transact. Febr. 10. 1667/8. p. 617 and an extract of a printed letter etc. Paris, Mai 15. 1668. Philos. Transact. Jun. 15. 1668. Nr. 36. p. 710.
41. An extract of the sentence, given at the Chastelet, by the Lieutenant in Criminal causes. April 17. 1668 in Paris. cf. Philos. transact. Dec. 13. 1669. Nr. 54. p 1075.
42. cf. Dionis, Cours de Chirurgie, p. 458 – Duhamel, Historie de l'Academie. p. 21 22.
43. cf. Philos. transact. Octob. 21. 1667. Nr. 28.
44. Stadera medica nella quale oltre la medicina infusoria si bilancia la Transfusione del sangue gia inventata da Francesco Folli. Firenze 1680.
45. Giornale dei litterati. apud Nic. Aug. Tinassi 1668. — Philos. transact. 1668. 4. December. p. 840. — Haller, Biblioth. med. practic. III.
46. Elsner, Ephemerid. nat. curios. I. 1684. p. 286. observ. 149.
47. De nova et inaudita operatione sanguinem transfundente de individuo in individuum. Roma 1668 mit Abbildung. – Relazione dell' esperienze fatte in Inghilterre, Francia ed Italia intorno alla transfusione del sangue. Roma 1668. – Haller Bibl anat 1 557.
48. Disquisitio de corde hominis physiol anatomie. Barein. 1694. Observ 24. de transfuse sang ex alt anim in alterum.
49. Of the antiquity of the transfusion of blood from one animal to another. Philos. transact. 1668 18 Juli p 734. – Haller, Bibl. Anat I p 266 – Auch citirt von P. Manfredi, I. c. Es sci übrigens erwähnt, das Libavius die Transfusion ent aller Entschiedenheit verwirft.
50. Chirurg. Lörbeerkrantz. Halberstadt 1684.
51. Im III. Band seiner gesammelten Schriften.
52. Eine ähuliche Stelle hat bereits Scheel nachgewiesen (1. c. p. S): De vita sana longa et coelesti. I. II. C. II.