DIE TRANSFUSION DES BLUTES UND EINSPREUTZUNG DER ARZENEYEN IN DIE ADERN

HISTORISCH UND IN RUCKSICHT AUF DIE PRACTISCHE HEILKUNDE BEARBEITET

BY: Dr PAUL SCHEEL (1802)

A TRANSLATION OF THE BOOK BY PHIL LEAROYD

The book 'The transfusion of blood and the injection of drugs into the veins: historically and in consideration of practical medicine' by Paul Scheel was published in 1802 in Copenhagen [by Bey Friedrich Brummer]. A copy of this 250 page book can be viewed at:

https://books.google.co.uk/books/about/Die_transfusion_des_blutes_und_einspr%C3%BC.html?id=SZFBYAAACAAJ&redir_esc=y

This book is actually the first of three volumes. Scheel added a second part to his book that was published in 1803, whilst the third volume was compiled by J.F. Dieffenbach and published in 1828 after Scheel's death. The three volumes can be viewed or downloaded together as a single 'book' at:

https://wellcomecollection.org/works/z5ng8tnz

The 1802 book is one of the foremost references for historical information relating to blood transfusion (and infusion) experiments performed in England, France and Germany prior to the 19th century.

I have translated 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. Whilst some of the words / terms used by Scheel are obviously open to interpretation, especially given the date that it was written, I have attempted wherever possible to maintain the author's original meaning, intent and detail, so as to make the translation as 'un-interpreted' as possible. As with any translation the wording may be purposely or inadvertently altered in an attempt to 'make it read better' but in doing that, 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. 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', especially as some letters and words in the original scanned text are not easily readable. The reader is therefore recommended to check specific details against the original German text. I have added a small number of comments in square brackets to occasionally clarify some words. All words in italics are as published in the original text.

The book begins with a twelve-page preface that includes two lengthy references and provides information regarding Scheel's plan for the book and comments regarding the use of material from original references and not second-hand information obtained from other authors. It also includes comments about the

difficulties that this caused in locating some of these documents, which took over two years of research. Schell then presents a directory of 131 of what he refers to as 'the finest infusion and transfusion references' available, which are not the same as those quoted in the text. The references within the text are included at the bottom of the relevant page related to the text and depending on their length these are frequently spread over two or more pages and are referenced to the text only by one or more asterisks on each page. I have therefore sequentially numbered these references (of which there are 198) and placed them in a separate list at the end of the translation.

As the title states, Scheel collects together information on both infusion as well as transfusion. The act of infusion of materials into veins is varyingly described by the author as having been achieved by 'injection', 'spraying' or 'sprinkling', or the infusion of air by 'breathing' or 'blowing' – I have interpreted these different words as the single word injection, though this of course was not always achieved using a syringe device, but also with a bag / pouch attached to a tube or similar piece of equipment (or in the case of air, by simply blowing air from the mouth into a vein through a hollow tube).

'Section 1' documents the recorded attempts of transfusion and infusion prior to the discovery of the circulation of blood, and principally includes information about Medea and Libavius (with a large amount of text in Latin), whilst 'Section 2' includes the information on the history of transfusion and infusion after the discovery of the circulation of blood by Harvey until the end of the 17th century. This second section of the book includes four sub-sections that follow both date and location order of events, i.e.

- Transfusion and Infusion in England: 1656 - 1667
  Mainly includes descriptions of the animal transfusion experiments encouraged and performed by members of the Philosophical Society, e.g. Boyle, Lower, Coxe and King; there is also a description of the infusion experiments performed in England during this period (see from §. 10).

- Transfusion and Infusion in France: 1657 - 1673
  Includes the transfusion research work performed on animals, primarily by Denis and Emmerez, as well as the background information regarding the conflicts of eminent Parisian physicians such as Boudelot, Gabets, Moreau/Lamy and Perrault regarding the use of blood transfusion. The early transfusion attempts made on humans by Denis and Emmerez are also recorded in detail, leading up to those performed on Antoine Mouroy and the controversy surrounding it. Scheel provides and excellently balanced report of this and the resulting legal challenge, as well as arguing that the resulting 'ban' in Paris was not actually implemented, and certainly did not apply to the whole of France (see §. 56 to §. 59). This section concludes with Drelincourt's infusion experiments.

- Transfusion and Infusion in England: 1667 - 1700
  This section reverts back to England to chronologically discuss the blood transfusions performed by Lower and King on Arthur Coga, and although Scheel identifies that there was an intent by members of the Philosophical Society to perform more human transfusions, these did not actually occur. The author also includes information about the infusion experiments performed by Courten, King, Mullen and Clayton (see §. 67) during this period.

- Transfusion and infusion in Germany: 1664 - 1700
  Scheel identifies that there was little experimental work on blood transfusion during this period, the vast majority of the research being on infusion and the author writes somewhat disparagingly about German research and researchers.

He does however catalogue in detail the somewhat bizarre, dubious and frequently very cruel animal infusion experiments that were performed, though it is difficult to see how they added any meaningful scientific or medical information.

The book does not include an index. However an index was printed in the second volume of Scheel's 'Die Transfusion des Blutes und Einsprützung der Arzeneyen in die Adern' that was published in Copenhagen in 1803 (by Friedrich Brummer). This includes the index for both volumes but is produced in shorthand-word type format that does not lend itself easily to an accurate English translation. I have therefore taken the liberty of producing a 'modified translation' of Scheel's index below that will hopefully make easier reading (and more sense).

INDEX

Note: This index includes some dates that are not included within the general text of the translation. The third column provides the page number of this translation.

Section 1: History of transfusion and infusion from the first uncertain traces of them to the first attempts with them after the discovery of the circulation of the blood.

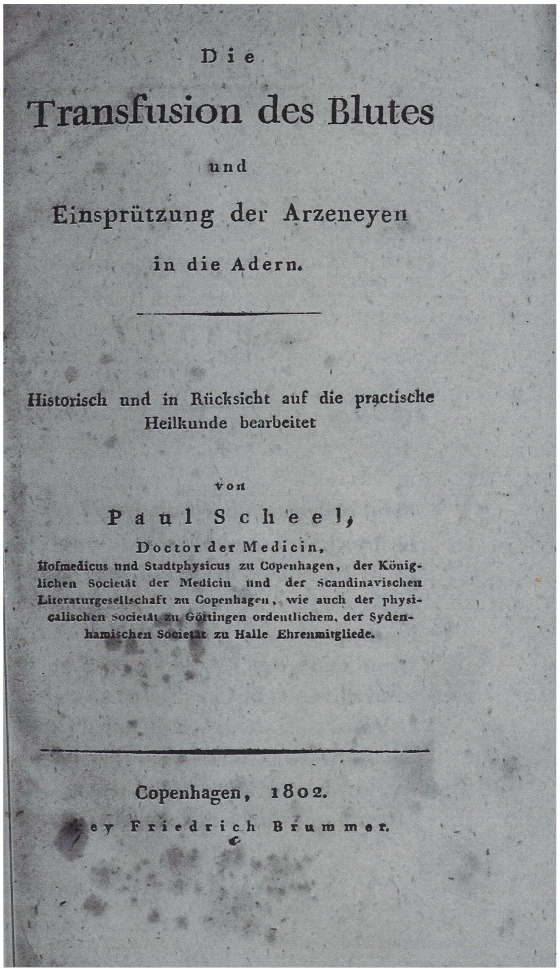
Section 2: History of transfusion and infusion from the discovery of blood circulation to the beginning of the eighteenth century.

History of transfusion and infusion in England: from 1656 to 1667.

History of transfusion and infusion among the French: from 1657 to 1673.

Transfusion and infusion in England: from 1667 to 1700.

History of transfusion and infusion among the Germans: from 1664 to 1700.


Die
Transfusion des Blutes
und
Einsprützung der Arzeneyen
in die Adern.

Historisch und in Rücksicht auf die practische Heilkunde bearbeitet

von
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Doctor der Medicin,
Hofmedicus und Stadtphysicus zu Copenhagen, der Königlichen Societät der Medicin und der Scandinavischen Literaturgesellschaft zu Copenhagen, wie auch der physicalischen societät zu Göttingen ordentlichem, der Sydenhamischen Societät zu Halle Ehrenmitgliede.

Copenhagen, 1802.
bey Friedrich Brummer.

Title page of 'Die Transfusion des Blutes und Einsprützung der Arzeneyen in die Adern' by Paul Scheel (1802)
(Image credit: Wellcome Collection)

Dr PAUL SCHEEL – BIOGRAPHICAL INFORMATION

Paul Scheel was born on 28th February 1773 in Itzehoe (Holstein), the son of lawyer Paul S. and Cecilie Margrethe Scheel. He was physically weak from his early childhood. He studied natural and spiritual sciences in Gottingen in 1791 and then, from 1794 he studied medicine in Copenhagen as a student of Mathias Saxtorph who, before he had graduated his Medical Exam (in 1796), got him employed as a reserve doctor at the Birth Foundation and then provided him with a Royal Travel Scholarship from 1796 to 1798, during which time he studied obstetrics at Osiander in Gottingen. Returning to Copenhagen, he acquired a Medical Doctorate in 1798 in obstetrics, settled down as a doctor, received the title Hofmedicus in 1801 and was appointed City Physician in 1802. About the same time he collaborated with other authors to produce German translations of the publications of the Danish Society of Sciences (1798-1800), one of which was Transfusion and Infusion (in 1801, together with E. Viborg). This dissertation he reworked into a detailed monograph: “The transfusion of blood and the injection of drugs into the veins”. In 1804 he was invited to be the Professor of Obstetrics and Gynaecology in Kiel, which he refused. His increasing tireless professional activities, especially as an obstetrician, together with his other extensive social and political commitments, compounded his already feeble physique. He contracted fever and died at the age of 38 on the 17th June 1811.

PREFACE

The reproach of having left the once famous transfusion of blood and injection of drugs into veins in undeserved oblivion no longer applies to the past and our present decade, since almost everywhere in the most cultivated parts of Europe men of merit and prestige did complete justice to these operations, and have loudly drawn attention to the benefits that could be derived from them not only for physiology but also for medicine. This endeavour of so many deserving men, with my deep conviction of how much transfusion and infusion deserves this attention, should please me not a little, and arouse in me the desire to do my best to see these operations worked on and examined anew; a desire to which contemporary writing owes its origin.

The plan I put in front of myself in drawing this up was:

1) To collect all attempts made with transfusion and infusion and put them together without omitting the slightest essential circumstance in order to be able to overlook what has already happened and what remains to be done in order to have sufficiently reliable attempts from which one can draw certain results.

The achievement of this intention was not possible without considerable effort, since those attempts, are mostly in ancient rare monographs (1), or scattered in larger works and in learned journals, and I only allowed myself to take them from the original scripts and not from second or third hand if I wanted to do them justice (2). Only with the help of the local Royal Library and the famous Göttingen University Library and by searching the other most prestigious libraries in Germany and Italy, for which a two-year journey made possible in other scientific respects with the most gracious support of our government that gave me the opportunity to collect with some completeness those attempts, which I hope to do more fully thorough addenda, to which I will gratefully use the contributions and corrections of critics and other literators.

(2) Not only to collect all the times that transfusion and infusion were attempted, but also to essentially compile the theoretical assessments of them and to give a review of all the writings on the subject, partly to provide a reasonably complete history of these remarkable operations, and partly to facilitate the judgment of these observations and experiments, since physicians and naturalists too frequently only relate these as it appears to them, through the coloured glass of a preconceived theory, which is nothing less than indifferent if one wants to make use of their observations and experiments.

Finally it was my intention

3) To draw the results from the collected attempts and to determine as much as possible to what extent theory and experience allow the use of infusion and transfusion in medicine with the hope of a happy success.

The historical part of my work is presented first, to which however, I have added the last section which contains the history of these operations from the beginning of the eighteenth century; the second section deals with the practical consideration of the use of transfusion and infusion in diseases for saving the lives of people and animals, partly because it would otherwise be too insignificant in volume, partly because I do not want to close my story without the interesting infusion attempts with which Professor Viborg is now continuing to concern himself, and the contributions, which have been most kindly promised to have been added to me by several respected

German scholars, namely Professor John zu Töplitz, of experiments that have not yet been printed.

To conclude this preface, a few words about the order I have observed in the history of these operations.

In my story I have put together separately what went on in each individual nation with regard to infusion and transfusion, so as not to have to pass too often from one nation to another in a strict chronological order and break the thread of the story. At the same time, however, when what happened or was written in one nation led the physicians and naturalists of another in their experiments or writings, then I broke off the history of that nation and began that of the other at the period that had the influence mentioned, in advance of the appropriate place. A synchronistic table at the end of this work will serve as an overview of the whole.

Since infusion and transfusion almost always went hand in hand with each other, and supported each other mutually, even if there were individual periods in which one seemed to forget one about the other, I did not believe that I could deal with each one individually.

Copenhagen, 5th April 1802

REFERENCES INCLUDED IN THE PREFACE

(1) I found out how rare they are through my repeatedly unsuccessful searches for them in many famous libraries. So for example, in the large Wolfenbüttler library I found none of the 53 writings of this genre, all of which belong to the age from which this library has the most books. I didn't do much better in the famous Imperial Library.

(2) I hope to adequately prove that neither Haller, with regard to the transfusion and infusion experiments, which he sets up excellently in his physiology, nor any of those who have drawn from him, could satisfy me. Haller was only interested in these experiments in his physiology insofar as they concerned the doctrine of blood circulation; Exhaustion in the narration of them would have been a mistake in that place, and great care in collecting and representing them seemed to him, on whose time so many important investigations lay claim, perhaps more unnecessary. Hence there arises some incorrectness which in my case would be essential errors. So for example, Haller (l. c. p. 228) cites No. 29 of the Philosophical Transactions in order to prove the deadly effect of vinegar sprayed into the veins, but their only experiments with vinegar and other acids are told that were added to blood let out of the vein. To illustrate the narcotic effects of injected opium, he quotes “Boyle Philos. Trans. No. 7, *Usefulness of experim. philos*., I, c., Garmanni *epist.* p. 30, Major l. c. p. 66, Borrichius de sanguine p. 85.”, as if just as many different experiments were being told in all of these passages, and yet all of them, with the exception of Garmann, deal with just a single experiment, which Boyle first relates in his *Usefulness of experim. philos*. op. cit. A mangy dog, says Haller is, according to the report in Philos. Trans. N. 25th, quickly cured of his disease by fresh blood; but it only says that a mangy dog, from which blood was transferred into a healthy one, became healthy again through this loss of part of its blood mass, and that the healthy dog did not become mangy from it. I do not find that Denys put horse blood into a young person's veins without damage, neither in Deny's writings nor anywhere else, although Haller claims it in his *Bibliotheca med. pract*. T. III, p. 250, although without citing his source. “The stupid young Frenchman, to whom Denys had given a little more lamb's blood through the transfusion, fell into phrenitis after the operation and died after the second attempt, soporous and with bloody urine, and the widow sued the doctors for this in court”, - so tells Haller from the Philos. Trans. No. 27, 28, 32, 36, 37, 54. But in the very passages mentioned by Haller you can read that it was a madman and not a fool who was given this transfusion, that he was given the blood of a calf and not a lamb, that the coincidences cited were not after the second transfusion, for he had been well for almost a month after it, but that he had finally died from a hot fever resulting from the abuse of strong drinks, or rather from the arsenic given to him by his wife during this fever, and that

it was not the doctors who carried out the transfusion that were challenged by the widow, but the widow by the doctors because of their defamation. Finally, in his *Biblioth. anatomica* (T. I. p. 695), Haller states Musgrave injected water into the veins of dogs, but the place where he cites for this from in the Philos, Trans, there are only attempts by Musgrave to inject water into the chest cavity of dogs. I could increase the number of such and similar passages from Haller's report on transfusion and infusion by a considerable amount if I did not already believe that there was enough of them. I was even less able to take infusions and transfusions from the later writers on this subject than from Haller, since most of them only drew from Haller, and far from correcting him, often added new inaccuracies. This is also the case for example with Hemman, who makes two different cases out of the unfortunate transfusion employed on the Swede Baron Bond, and for one case No. 28, Philos. Transact., whilst for the other No. 30 is quoted, however in these two places only the Baron Bond is mentioned, whose story is told for the first time without his name, whilst the second time, which is mentioned in No. 30., he is expressly recalled. Likewise, when he talks about the infusion attempts in Danzig, he tells of two syphilitic soldiers who were cured by the infusion, where only one is mentioned; furthermore, he runs (to give a little proof of the volatility of his work), a sick person who is also produced by this, a farmer, of whom it is said that he has "*tempore messis instante*" (*it being harvest time*, in Engl. Orig.) leave the hospital to return to his hard work as a peasant, to go to mass instead of sending him out into the fields to harvest (see his Med. Chir. Aufs. p. 170. et al. O). This may be enough to prove that, in order to be able to judge properly about the transfusion and infusion attempts made in the previous century, it was not at all superfluous to locate and collect the facts faithfully and unchanged from the original writings.

DIRECTORY OF THE FINEST INFUSION AND TRANSFUSION RELATED WRITING *

* I am putting them together here in a group, partly for the sake of clarity, partly to save space, so that when I cite them, I may not add the entire title, but only a brief reference to this list. Those of you who deal solely with transfusion or infusion, or which contain many or important experiments, I have referred with an asterisk.

1. Vanan Aalsem .disp. de humoribus; Leidae 1771.
2. Acta Hafniensia, Vol. III. 1675. 4.
3. Joh. Alos disquisitio de corde hominis anatomico - physiologica; Barcinonae 1694.
4. *(Simon. Allius) *Rilazione* del'esperienze fatte in Inghilterra, Francia ed Italia intorno la transfusione del sangue per tutto Gennaro, 1663. Bologu. 1668. Rom. 1668. Segov. 1698. 4.
5. Arcissewski de curatione podagrae.
6. Baldingers neues Magazin für Aerzte, 147 Band, 5 Stück.
7. *Thom. Bartholini epist. de Chirurg. Infusor. Francof. 1665. 12.
8. *Louis de Basril, Avocat en Parlement, réflexions sur les disputes, qui se font à l'occasion de la transfusion, 4. 7 Seiten. Ohne Druckort und Jahrszahl.
9. *Georg. Bagliv praxis medica, Rom. 1696. 8.
10. *Ejusd. Libellus de fibra motrice et morbosa, nec non de experimentis ac morbis salivae, bilis et sanguinis etc. Perusiae 1700. 8.
11. *Ejusd. dissertationes variaé in Oper. omn. p. 465. Lugd. Bat. 1745.
12. Joh. Christophori Bauzmann dissert. inang. de Peste, Lugd. Bat. 1673. 4.
13. Becket collection of tracts.
14. *Birch History of the Royal philos. Society, 4. Vol. II. 1757.
15. Bichat Recherches physiologiques sur la vie et la mort; Paris 1800. 8.
16. Blumenbach introduct. in history. medicinae literariam; Gott. 1786. 8.
17. *Ej. Medicin. Bibliothek, T. I. Gött. 1783. 8.
18. Olai Borrichii Dissert. seu orationes academicae, edit. a Sever. Lintrupio, Hafn: 1715.
19. *Robert Boyle certain physiological essays on the usefulness of natural philosophy; Oxon. 1663. 4.
20. Joh. Bohnii circülus anatomico-physiologicus; Lips. 1710. 4.
21. *Breslauer Sammlungen, 1718. 4.
22. Brinkmann Beweis der Möglichkeit, dafs einige Leute lebendig können begraben werden; Düsseldorf 1772. 8.
23. Bradley, vid. Fischer's med. chir. Bem. über London und die Engl. Heilkunde; Göttingen 1797. 8.
24. *J. Conrad Brunner exper. nova circa pancreas accedit diatribe de lympha et genuino pancreatis usu; Amstelod. 1633.
25. *Bruntorf diss. de Chir. infusor. Rostock 1703.
26. *Bulletin des sciences par la Societé philo-mathique de Paris; Germinal an 5 de la Rep: No. 3.
27. Cantwell lettre adressé au Mercure de France, Juin 1749.
28. Johann Colle methodus facile parandi tuta et nova medicamenta; Venet. 1628.
29. Collect. academ. Divionensis Partie étrangère, Vol. II.
30. Colbatch append. concerning acids and alcali; Lond. 1704.
31. Crifgentius de febribus.
32. *Mich. Crugener ortus et progressus clysmaticae, 1667. 4.
33. Darwins Zoonomia; Lond. 1796. Vol. I. II. 4.
34. *Anton Deidier, Med. Conseiller du Roi et Prof. dans l'acad. de Montpellier, experiences sur la bile et les cadavres des pestiverées accompagnées des

lettres du dit Mr. Deidier de Mr. Montresse, Dr. en Médec. et de J. J. Scheuchzer, Dr. en Méd. Prof, des Math, etc. Zuric en Suisse. 1772. 8.

35. *Jean Denis extrait d'une lettre à M . . . sur la transfus. du sang; Paris 1667.
36. *Lettre escrite à Mr. Montmor par J. Denis, Professeur de Philosophie et de Mathématique touchant deux expériences de la transfusion faites sur les hommes; Paris 1667.

    Auch unter folgendem Titel:
37. *Lettre escrite a Mr. Montmor, Conseiller du Roy en ses Conseils, et premier Maistre des Requestes par J. Denis, Professeur de Philosophie et de Mathématique touchant une nouvelle manière de guerir plusieurs maladies, par la transfus. du sang, confirmée par deux expériences faites sur des hommes; Paris 1667. le 25 Juin 4. 18 S.
38. *Lettre escrite à Monsieur **** par J. Denis, Docteur en Médecine et Prof. de Philos. et de Mathém. touchant une folie inventerée, qui a esté guerie depuis peu par la transfusion du sang; Paris le 12 Janvier 1668. 4. 12 S.
39. *Lettre escrite à Mr. Sorbiere, Dr. en Médec. par J. Denis, aussi Dr. en Médec. touchant l'origine de la transfus. du sang, et la manière de la pratiquer sur les hommes avec le recit d'une cure faite depuis peu sur une personne paralitique; Paris ce 2 Mars 1668. 4. 12 S.
40. P. Dionis cours d'operations de chirurgie; Paris 1707. 8.
41. *Carol. Drelincourt experimenta anatomica ex vivorum sectionibus petita; edita per Heyseum; Lugd. Bat. 1634. 19.
42. *J. Sigismundi Elsholzii clysinatica nova, sive ratio qua in venam sectam medicamenta immitti possent, ut eodem modo operentur ac si ore admissa fuissent, addita inaudita omnibus saeculis transfusione sanguinis, Colon. Brandeb. 8. 1665. 1667. 1668. Francof. cum collegio anatomico Severini et aliorum. Bald nach Erscheinung der ersien Ausgabe, gabder Verf. selbst eine teutsche Uebersetzung davon heraus, deren Titel ich nicht genauer weiſs.
43. *Ephemerides naturae curiosorum, Ann. 1. et seq.
44. *Michaelis Ettmülleri diss. medica de chirurgia infusoria, pro loco in Univers. Lip siensi obtinendo d. 30 Oct. an. 1668. defensa, Lips. 4.
45. *Ejusd. de Chirurgia transfusoria, dissert. Lips. 1682. 4. in ej. Oper. omn. T. III. fol. Francof. 1697.
46. *Eutyphronis de nova curandorum morborum rationeper transfusionem sanguinis; Paris 1668.
47. *Caroli Fracassati ad Marcellum Malpighi epistola de cerebro et lingua; Bonon. 1665. 12. in ej. et Malpighi epist. anatom. 1669. 12. Amft.
48. *Joh. Friend emmenalogia, in qua rationes fluxus muliebris menstrui, phaenomena, periodi, vitia cum medendi methodo ad rationes mechanicas exponuntur; Oxon. 1703. 8. in ej. Oper. omn. Londin. 1733. fol.
49. Fuller some new hints relative to the recovery of persons drowned; Lond. 1735. 8.
50. *C. Gadroys lettre escrite à Mr. L 'Abbé Bourdelot, Dr. en Médec. de la faculté de Paris, et premier Médecin de la Reine de Suède, pour servir de reponse au Sr. Lamy et confirmer en mesme temps la transfusion du sang par de nouvelles expériences; Paris le 8 Aoust 1667. 4. 16 S.
51. Chr. Frid. Garmanni epistolarum centuria, e Museo Iman. Henr. Garmanni; Rostocki et Lips. 1714.
52. Caroli Gianella Saggio di Medicina teoretico - practica; Venez. 1732. 8.
53. *(J. Henr. Glaseri) Ortus et progressis clysınaticae novae, oder Anfang und Fortgang, der nenerfundnen Klystirkunst, 1667. 4. ohne Druckort.
54. *Wohlgemeynte Ueberlegung der Hauptgründe, welche in einer sogenannten Clysmaticae novae ortu et progressu angeführt werden, 1667.
55. *Regn. de Graaf de clysteribus et usu siphonis; Lugd. Bat. 1668. 8.
56. Ej. defensio partium genitalium contra Swammerdamm; Lugd. Bat. 1673. 8.

57. *Lettre escrite à Monsieur L'Abbé Bourdelot, Dr. en Médecine de la faculté de Paris, premier Médecin de la Reine Christine de Suède, a present auprès de Mons. le Prince de Chantilly, par Gaspard de Gurye, Ecuier Sieur de Montpolly, Lieut, au regiment de Bourgogne; sur la transfus. du sang, contenant des raisons et des expériences pour et contre; Paris le 16 Sept. 1667. 4.
58. *J. Ludov. Hanemanni nova ars clysmatica enervata; Siadae 1670. 12.
59. *Du Hamel historia Academiae regiae scienatiarum; Paris 1698. 4. Lps. 1700. 4.
60. J. S. Harderi apiarium observationibus medicis et experimentis refertum, Basil. 1687. 4. unter einem andern Titel: Thesaurus observationum medicarum rariorum; Basil. 2736. 4.
61. Halleri Elementa Physiologiae, T. I. II. Lausann. 1754. 4.
62. *Ej. de motu sanguinis surmo, quo experimenta continentur Gottingam missus d. 24 Febr. 1756. Französisch: Second memoir sur le mouvement du sang; Lausann. 1756. in
63. Ej. Oper. minor. T. I.
64. Ej. Bibliotheca anatom. T. II. 1774. Tigur.4.
65. Ernesti Henr. Häfner diss. deinfusione et transfusione; Jenae 1798. 4. 24 S.
66. *J. A. Hemmann medicinisch - chirurgische Aufsätze; Berlin 1778. 8. 2te Aufl. 1791.
67. Heisteri institutiones chirurgiae; Amstelod. 1739. 4.
68. *Anton de Heyde anatomemytuli, cui subiecta est centuria observationum medicarum; Amstelod. 1686. 8.
69. *Histoire de l'Académie des sciences depuis son établissement; Paris 1733. T. I, II. oder: Memoirs avant 1699.
70. Historical Magazine, 1792. Lond. 8.
71. *J. Danielis Horstii iudicium de Chirurgia infusor. Francof. 1665. 12.
72. *Journal des Sçavans; Paris. 4. vorzüglich 1667 und 1722.
73. *Francisci Kleinii disput. an sanguinis transfusio utilis sit et adhibenda; Herbipol. 1680. 4.
74. *Ejusd. sanguinea apollineae palaestrae acies, quam sine strage coccis visum, surdis auditum, deliris mentem, vetulis iuventutem, uxoribus pacem resümnendo, instruxit autor, dum Dominum Joh. Vit. Helmuth medicinae Doctorem crearet; Herbipol. 1680. 4.
75. Kingii Opera, 1667. Lond. 4.
76. Krügers Pathologie; Halle 1750. 8.
77. *G. Lamy Maistre aux arts en L'Université de Paris, Lettre à Mr. Moreau , Dr. en Médecine de la faculté de Paris, Conseiller, Médecin, Lecteur et Professeur ordinaire du Roy, contre les prétenduës utilités de la transfusion du sang, pour guerir des maladies, avec la reponse aux raisons et expériences de Mr. Denys; Paris le 8 Juillet 1667. 4. 15 S.
78. *Ejusd. Lettre escrite à Mr. Moreau, Dr. en Médec. etc. dans laquelle il confirme les raisons qu'il avoit apportées dans sa première lettre, contre la transfusion du sang, en repondant aux objections qu'on luy a faites; Paris le 26 Aoust 1667. 4. 16 S.
79. *Ej. Lettre à Mr. Moreau, Dr. en Méd. dans laquelle est décrite la mort du fou prétendu gery par la transfusion, avec un recit exact de ce qui s'est passé aux transfusions qu'on luy a faites, et quelques réflexions sur les accidens, qui luy sont arrivés; Paris le 16 Févr. 1668. 4. 11 S.
80. *Lanzonii Ferrariensis, Phil. et Med. Dr. diss. medica de clysteribus; Ferrariae 1691. in ej. Oper. omn. T. I. Lausann. 1738. 4.
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SECTION 1

HISTORY OF THE TRANSFUSION OF BLOOD AND ITS INFUSION INTO THE VEINS OF LIVING ANIMALS, FROM THE FIRST UNCERTAIN TRACES OF THEM, TO THE FIRST ATTEMPTS WITH THEM AFTER THE DISCOVERY OF THE CIRCULATION OF THE BLOOD

§. 1

As an introduction to this story of transfusion and infusion, I am giving a brief explanation of the names of these operations for the few of my readers who do not know them well enough.

We call blood transfusion the surgical operation in which, by means of suitable tubes, the blood is transferred from the veins of one animal into the veins of another. By Irishman Vehr (1) it occurs under the name *Methaenochymia*, in Major (2) under the name *Transplantatio medica nova*; Olaus Borrichius (3) names it and infusion after its believed inventor: Medea's Cura Method (*Cura Medeana*).

Infusion (4), (Infusio or *Chirurgia infusoria*), Elsholz's *Clysmatica nova* (5), or new clysmatic art (as opposed to the common Clystiere), is that operation in which any liquid is obtained by means of a syringe or a similar instrument, drives directly into the blood vessels of a living animal.

In the middle between these two operations stands the *Transfusio infusoria*, or the transfusion by means of a syringe, by which one collects the blood that one wants to bring from one animal into the other in a syringe, and then into the veins of the animal, to whom one wants to communicate it.

§. 2

Over the origin of these operations there is the obscurity in which the origin of so many other inventions is shrouded. There is, however, no lack of conjectures about this subject, and I must not leave at least the most excellent of them unexamined here.

Among these assumptions, the one according to which the invention of transfusion and infusion is certainly ascribed is to the famous sorceress Medea. At a time when people resisted trying to make the invention that one was interested in as old as possible and, if not by Adam himself, at least tried to derive it from the venerable age of Moses or Homer, the friends of transfusion and infusion had to be happy to be able to give them such a famous inventor from the times of the heroes. (6) The enemies of these operations were also happy to be satisfied with this, for it gave them the opportunity to condemn them as the invention of a cruel sorceress stained with the blood of her own children, for example, to quote just one, Mr. Martín de la Martiniere does it in all seriousness.

Medea is believed to have made deceased old people young again through this invention. Ovid is responsible for this, through the rejuvenation of Aeson as told in the 7th book of his Metamorphoses. Jason and his Argonauts return safely from Colchis; everyone happily comes to meet him, except his father, whom he hardly finds alive because of his weakness. He begs his wife to extend his father's life; she promises it, gets on her dragon-chariot, and seeks everywhere for what nature has to offer her, powerful magic herbs and other things, and from them she prepares magic juices, from the touch of which even a dry olive branch is revived. Here are Ovid's words according to Mr. Voss' translation:

“Then she with such things, and a thousand unnameable others
Your chosen gift made in a marble mortar;
Immediately stir them with the withering branch of the noble olive tree

All together in ore, and mixes the lower to the upper.
See the outdated stump whisked in the boiling kettle
When it first grows full of juice, it does not take long before it sprouts
Leaves, and suddenly it appears slung with full olives.
And whither the foam of hollowed ore the fire
Sprayed where only boiling drops fell on the earth,
The field billows, and flowers and herbs rise happily.
As fast as you saw it, your throat with your sword drawn
Open Medea to the old man and let out the stale blood,
Then fill again with juice; and as soon as the mix Aeson
Sucked in through the throat and wound, suddenly shimmered
Beard and aging hair, and curls in dark curls
Wrinkles and leanness flee the bulge and paleness disappear;
The hollowed veins are crowded with new blood;
The growth revels in youth. The newly created Aeson
Marvel and feel completely, as once from the fortieth year." (7)

Another passage in Ovid is said to have reference to transfusion, namely the one where he tells how Medea seduces Pelias' daughters to parricide by promising to make her old father young again just like Aeson.

"The daughters stepped across the threshold with the Colcher woman,
And they went around the bed: What now, cowardly your lines?
Twitch, she said the sword, and scoop up the stale blood,
That I freshly fill his veins with youthful redness,
Your hand is familiar with the life and old age of the father
Have filial love and do not cherish vain hope;
Faithfully perform the duty to the Father! Age with arms
Chased out and tapped the sober liquid manure with iron!" (8)

It could not occur to me to believe from what has been said that Medea had really rejuvenated old men through an operation like the one Ovid describes, but it seemed to me to take the trouble to examine whether Ovid might not have found an older source material for this fable, and whether ideas of transfusion and infusion could not also be found among the older Greeks: with this in mind I looked for Diodorus Siculus, Apollodorus, Pausanias, Hyginus, Photion, Themistius, Paläphatus and the like after, but without finding anything. All who speak of Medea's art of rejuvenating old people cite this by cooking in a boiler, i.e. happened through warm herbal baths, so it is Ovid's poet's fantasy that created Medea's method of rejuvenation, as it stands in his Metamorphoses. A letter from Hofrath Heyne, in which he answered my question: whether perhaps there might be something in the ancients that Ovid might have been guided in his story, answered with his own most pleasant manner and with his own erudition and acumen, made this even more plausible to me.

§. 3

In the writings of the Platonist, Marsilius Ficinus, who was so famous in the fifteenth-century, one claims to have found an idea of transfusion, “Careful doctors” he says, (*De vita sana, longa et coelesti*. L. ll. C, ll. *de Studiosor sanitate tuenda*. Florent 1489. Fol.), “seek to strengthen people who are emaciated from old age by means of medicine obtained by distillation from human blood. Why should such patients not be able to recover by drinking blood? Old witches or fiends, as they are called in common life, could, according to an old and prevailing opinion, suck the blood of children in order to become young again. Why shouldn't our old men too, otherwise there is no other help for them? Suck a healthy, cheerful, moderate young man who

has very good but perhaps too much, blood? So let them suck an ounce or two of blood from a small opening in a vein on their left arm in the manner of a Platonist (9). Obviously these words contain nothing but a suggestion to have fresh blood drunk in order to restore one's strength, and Marsilius can have little claim to the honour of inventing transfusion or the inducement to this invention, that I would not mention him here if it were not because he is mentioned from time to time as the inventor of it.

But even if the blood-sucking of Marsilius Ficinus and the rejuvenating arts of Medea were nothing less like transfusion or infusion, both deserve to be mentioned in our history, since they, like Hemmann (1. cp 125) and others correctly point out, they may well have given rise to the invention of these operations. As is well known, in previous centuries people looked for deeply hidden chemical and medicinal wisdom in the ancient mythologists, and the doctors of that time, who discovered Ovid's fable of Medea during such an investigation, were all the more able to rely on the invention of transfusion and infusion, because such a healing method harmonized so closely with the theories prevailing among them. As is well known, the sentence also adopted by the ancients: the seat of life is in the blood, among the Christian physicians through the well-known mosaic passages almost become an article of faith; has almost become an article of faith among Christian doctors through the well-known mosaic passages; her most ardent endeavour in her curative methods was to work properly on the blood, and especially that with its supposed Flammula vitali, and the blood itself, or the medicines prepared from it, seemed to them powerful cures for most diseases. Under such circumstances, the slightest reason had to be enough to direct them to transfusion or infusion, which must have seemed to them the most incomparable method of acting quickly and directly on the supposed source of life, the heart. Perhaps some of the foolish sympathetic arts of that time (10) contributed to the invention of these operations.

§. 4

Ideas of this kind probably led Magnus Pegelius, Doctor of Medicine and Professor of Mathematics at Rostock (where he was born in 1547) to claim the invention of transfusion or infusion, towards the end of the sixteenth century. The first traces of this invention of his are contained in the *Thesaurus rerum selectarum, etc.*, (11) written by him at least 10 or 11 years before it was published in 1604 but dated from 1593; a work through which he sought to make himself and his many important discoveries known in a way that borders to a high degree on the boastful and charlatan, namely pag. III., where he speaks of “an excellent and rare surgical method by which man can be communicated from without what is beneficial to him, and much of what is within him can be averted which would harm him. A method, which can in some ways affect and change people.” (12). This passage is not very clear, nor is it such that it can be applied to infusion or transfusion; but also not of the kind that, as Mr. Hemman thinks (op. cit., p. 127), it can be understood just as well by clysts as by those operations; it can be understood just as well by clysts as by those operations; for it would hardly have occurred to Magnus Pegelius to call the enema, which is so generally known from time immemorial, a “*Rationem chirurgicam insignem et rarem*”. I cannot say whether there are other passages in his *Thesaurus* that relate to our subject, as I have not yet been able to search through the book myself, and the passage cited above I had to take from the *Paschius de inventis nov. antiquis Cap.* VI. p. 304. For a presumption regarding the level, see the end of the following paragraph.

§. 5

The famous Andreas Libavius from Halle, doctor of medicine and director and professor at the Gymnasium in Coburg, gives the first unambiguous traces of a

transfusion among all, in his *Apprendice necessaria Syntagmatis arcanorum chymicorum*, Cap. IV, p. 7, printed in 1615 and thereby secures the honour of their invention for the Germans, according to the own confession of the nations who quarrelled about it (13). However, the way in which this operation is first performed by him here is just not fabulous for them: for Libavius speaks of it and its inventor, an unnamed charlatan, with the greatest contempt. But he was certainly not a mean charlatan, and even if he were, he deserves because of his invention that I should familiarize my readers more closely with him, as far as it can be done from what Libavius says of him. I therefore quote the entire passage, which is remarkable for the history of transfusion, in Libavius' own words (14).

In the cited work, in which Libavius chastises the Paracelsist Scheunemann and his comrades of merit, our anonymous charlatan prompts him to the following episode, to which we owe the first news of the transfusion: “The Paracelsists take pleasure in such nonsense. However, someone also came to the fore who did not want to be from Paracelsus' flock, and who nevertheless trumpeted magnificent and admirable things, and whose arts which he boasted, that I wanted to enumerate here in a few words in order to give my readers a better understanding of this species of people. At first he promised a means by which one could make fields highly fertile and highly fruitful all over the world, and the like.” We have now heard one of his memories from agriculture, now we want to get to know one about medicine too, which makes up the second of his great promises. He proposes a type of treatment that affects the arteries and veins, and consequently the whole person. What is this then? In a new, unknown, never hoped for, most salutary operation and undertaking, in an immediate original method, to live, to nourish oneself, with or without the help of things taken through the mouth, according to their nature and place and time of their invention to heal. What advantages does this grant? It gives us the hope of renewal; and what more? It creates for us a special, hitherto completely unknown way of doing most of what one only wants and what one could otherwise not hope to do in the whole person and in his parts, so that he receives good and is freed from evil. A consequence of this is the arbitrary change in the minds of men and their most excellent inclinations and passions. Do we want someone to be courageous? The new art will make him so! Do we want to have him sedate, gentle, alert, lively, benevolent, good, briefly in all respects, just as one might wish? It will be done through the same! In this way day-end, goodness, and magnanimity can be carried over from one person to another without his disadvantage. Should this new state of mind be changed into another, or become the previous one again; this is also easy to achieve. Tritemius taught a prince to learn Latin in an hour, but took this gift again from him, although he had been freely given for it. What else can you do with it? In this way one can cause the courage and strength of a young man to pass into an old man, and the healthy constitution of a healthy and well-being into a sick man; that a person who is not yet completely dead, or any part of the same who is about to set on fire, will be given new life, and paralyzed parts will be regained movement and strength; that furthermore the whole body is nourished or changed as desired, even if neither the stomach nor the liver carry out their functions and only work poorly or not at all; finally, once one has only found what is useful to everyone without antipathy, one can overcome all otherwise incurable diseases and ills. In this way a person can become healthy in body and soul, and acquire a larger, unusual and, beyond his hope, excellent physique. But what is it that can do such great things? We find that the father of the Rosicrucian sect protected his own from all disease by a powerful preservative from the Philosophical Tincture; others recommend antipathetic characters; but still others praise Paracelsus' elixir from the seven planets, or the dry or damp mummy of man and the like for this purpose. But our man, how does he hope to achieve these wonderful things? - Through the following art. Suppose you have a strong, healthy young man rich in spiritual blood and a powerless, lean, emaciated, barely breathing old man. If the doctor now wants to practice the art of

rejuvenation on the latter, he has silver tubes made to fit into one another; then open the artery of the healthy man, bring one tube into it, and fix it in it; then he opened the patient's artery and fastened the other female tube in it. These two tubes are now inserted into one another, and in this way cause the warm and spiritual arterial blood of the healthy person to overflow into the patient and inform him of the source of life, and drives away all weariness. But won't that healthy person be weakened thereby? Well, you give him good tonic and food after the operation, but the doctor is given hellebore."

In the third chapter of his *Promissorum grandiuen*, our Charlatan promises an art that has been brought up again today in France to transplant sea fish into other sweet waters and to make them indigenous there, the like of which does not belong here. The fourth chapter, however, again relates to transfusion, which is why I am returning this passage here in the words of Libavius (15).

"Our man promises to make the sterile fertile through special and desired means, if only there is no antipathy between the two people. As of even old, worn-out women? Of course, these too, and barren old men too. For here one must use the means of rejuvenation to help, so that those barren, regardless of their advanced years, can nevertheless become youthful and capable of fathering children. Of course, if one transfers new blood and spirits and courage and warmth from fertile youths into the body of the old, one can hope for something if our doctor does not deceive us otherwise. Does this art offer no other advantages? Of course! For it is not enough that old women are rejuvenated and have children by this, as it were by Medea's magic and the decoction of herbs, it enables us to make sure that a boy or a girl is created and born at will; that from the first conception the whole person is more pure, better, healthier and less subject to illnesses and accidents and strange desires, for which the means are taken over from other fertile ones (by taking blood from other women for one woman, for but draws a man from other robust men), so that man is born better and happier in body and soul than he can become without those excellent methods and desirable means through ordinary production."

As far as Libavius or the unnamed inventor of transfusion, about whom and about whose all important inventions and arts he brags, Libavius poured out the bitterest ridicule, as one declared opponent of the charlatanry and ruling at that time, it is regrettable that the resulting contempt for our unnamed, it seems to me, only causes him to relentlessly state his words with obvious ironic exaggerations and interferences, and that he does not consider it worth the trouble to say the title of the work from which he extracts it. Perhaps we are not told the name of the author, for the same seems to have a strict incognito, but look at p. 10, which places Leviticus on himself: "…*domicinum sum a nullo inventum iri, et si quis vent insidiari thesauris, ipsum hoc facturum cum mango suo damno*." But Libavius seems to know him, for he adds to the passage where our unnamed one boasts of the invention of profitable financial operations (16): *at tu promissor eras pauperior Iro*. What makes me believe that our inventor of the transfusion was at least not a very common charlatan is that he did not join the ruling mystical chemical sects, and the union point of almost all charlatans of his time, the Paracelsus or the Rosicrucians, ("*De Grege Paracelsi esse nolebat*" Libav. p. 7.), that he rather declares alchemy to be folly ("*Chrysopoeam sapientum veram esse negabat, quod qui eam maxime profiterentur essent pauperes et infelices*" l. c. p. 9.), and finally that even in addition to transfusion, some of the arts and inventions of which he prides himself, do not seem entirely insignificant and at least bear the stamp of originality (17).

When comparing the little that I find in Fecht or Schaperus Medicina curiosa of the Thesaurus of Magnus Ebeneius with what Libavius gives us about our unnamed, I noticed not a slight resemblance between them, which I found even more confirmed as I read the work of Ebeneius himself, for which I had looked in vain in the most prestigious libraries in Germany and Italy, and finally found in the equally rich Electoral Library in Dresden. Both give only the titles of the inventions, but in these

there is a striking agreement. The inventions of the unnamed in Libavius are, however, indicated somewhat more clearly than they are in the Thesaurus of Pegelius; if the former for example speaks of a *Machina paedhulca* for childbirth (see above), Pegelius promises only one invention: ut gravida sive parturiens liberetur seu pariat modo mirabili et exoptato, eoque tali qui indicatus mox cerius et optimus percipitur etc. Adeoque si quis Astrologicorum effectuum *credulus* idcirco partus horam et momentum quasi efficere desiderat, id quoque agere et attentare hinc poterit. Furthermore, if the unnamed person describes the transfusion of blood in a lengthy manner, then Pegelius in that passage of his thesaurus, which I could only cite incompletely from the Schaperus in the previous paragraph, and which with great reluctance I therefore give here in full from the original: “Ratio chirurgica insignis et mira Homini communicans Extera quae ipsi bona, et Interna multa quae noxia avertens. Quae etiam ratio alias varia agere et alterare in homine potest. Modus omnino singularis, item hucusque plane incognitus quo plurima et insperata in homine toto eiusque partibus effici possunt, sic ut bona acqairat et noxiis privetur. Sicut ex re ipsa mox revelata mox percipitur et inde sequentia imprimis quatuor res ipsa docet, per experientiam in usu trahenda, 1) animi hominis et praecipue voluntatis et affectuun muratio, sic ut quis magnanimus, seu animosus, excitatus, sedatus, placidus, benevolus, bonus hoc aut illo modo affectus reddatur. Ut alterius virtus, bonitas, animositas etc. (idque sine alterius in hisce minutione seu detrimento) transferatur in alium. Ut item affectio talis si quando velles iterum mutetur in pristinam s. in aliam. Seni de Juvenibus, Aegroto de Sanis communicetur. 2) Vitae ipsius seu per hominem totum seu in parte ipsius hinc inde instauratio, Motuum effectio, restitutio fortificatio. 3) Corporis totius vel eiusdem partis variae nutritio etc., et talis quidem quam expetis; utcunque etiam ventriculus epar etc. virtute defecerint, nil vel male egerint. 4) Unde morborum et affectionum fere omnis generis alias etiam curam respuentium curatio postquam quid cui conveniat sic expertus fueris. 5) Unde item homo licet corpore et animo sanus, maiorem et alias non consuetam et insperatam sanitatem et constitutionem acquirere poterit.”

A detailed parallel between their mutual inventions would lead me too far here; what has been said above may suffice as a test, since the rest of the statements almost agree with one another in a similar way. I have therefore no hesitation in declaring our unnamed person and Libavius to be one and the same and who consequently has the honour of inventing the first transfusion. Perhaps Libavius wrote the anonymous script in order to create a sensation for his inventions under a different form, which he had tried in vain to attract with his thesaurus.

As undoubtedly the invention of transfusion falls into the time of Libavius, I believe I have to cast doubt that this operation, as Mr. Hemmann claims (18) that it was actually carried out at that time. Not counting that Mr. Hemmann cannot produce any evidence for it (Libavius apparently only speaks of a proposal for the transfusion, and lets it be done in a way that certainly nobody will undertake it, namely from an artery to an artery), the imperfect knowledge about blood circulation by Aerzie at that time, which in itself had to make the practice of this operation, which was already associated with many difficulties even more difficult seems to me a significant reason against his assertion.

§. 6

Thirteen years after the publication of the often-mentioned book by Libavius, we find an occasional mention of transfusion by an Italian writer Johann Colle, Professor at Padua. Where he is talking about foodstuffs and chemical medicines for the extension of life and the defence of old age (19), he speaks of an objection which he might perhaps raise; namely, that everything that he aims to achieve through his medicine can be obtained far more easily by drawing blood through a tube that transfers it from a perfectly healthy youth to an old man (20).

But he does not say where this proposal came from; just as there is little sign in his words that a transfusion was actually carried out at that time; rather, he himself disapproves of it for being inappropriate for several reasons. But that he must have been familiar with the idea of this operation at the time can be inferred from the way in which he speaks of it as an inconspicuous thing.

I cannot decide whether traces of transfusion or infusion might be found among the Arabs, since I did not have the opportunity to investigate them; just as little can I, for this very reason, judge whether and how early these operations were known to the Chinese. The latter seemed to me worth mentioning because, if not the doctors in China, at least the butchers there know and practice a kind of infusion which Careri tells us about in his journey (21).

SECTION 2

HISTORY OF TRANSFUSION AND INFUSION FROM THE DISCOVERY OF THE CIRCULATION OF BLOOD UNTIL THE BEGINNING OF THE EIGHTEENTH CENTURY

§. 7

With the great discovery of the immortal Harvey begins the more important part of our history, for only now do we find, instead of mere indefinite suggestions, undoubted and frequent practice of transfusions and infusions on animals and even on humans. The discovery of the circulation of blood not only taught the easiest and most correct way of performing these operations, but also led, since they were found to confirm the Harveyian discovery, to the frequent practice of them on animals; but also, apart from the experiments made in this and other physiological respects, the use of transfusion and infusion for the cure of diseases should now become extremely frequent. The doctrine of blood circulation made it clear to the doctors of that time that it was possible to change the whole blood mass of an animal, and that any medicament injected into a vein must gradually be imparted to the whole blood mass and applied to all parts of the body. The conclusions which they drew from this with regard to the crude humoral pathology prevailing among them, and the undertakings to which it led them, are easy to imagine: their expectations of transfusion and infusion were extremely great, their investigation of them very eager, and the number of attempts considerable, although in the end the lack of correct pathological and therapeutic knowledge, unfortunately for these operations, brought about many not only useless but also wrong and disadvantageous experiments on humans and animals that in the end, because one did not write the failures on account of the wrong application, as it would have been cheap, gave up all hope of drawing advantages for medicine from it, and therefore left it almost entirely.

Almost everywhere in this period one became aware of transfusion and infusion by examination of the circulation of blood; they were regarded as objects of importance, and the honour of having invented them was of no small value. Hence the not insignificant number of those who made a claim, and often fought very hard about it, or at least tried to attribute the honour of invention to their nation. To settle this dispute and to determine the validity of the various claims to the honour of the invention, it is up to me as the historian of these operations to be sure, but since the mere narration of these claims and the facts pertaining to them, will place the reader entirely in the position to make a decisive judgement on this issue, I do not want to anticipate it here, but again to the simple one. Turn to the narrative of the events.

§. 8
After the publication of the circulation of blood (1628), it took a long time before transfusion or infusion were actually practiced, and it was even longer before regular scientific experiments were carried out with it.

Infusion, which because it was easier to carry out, preceded transfusion almost everywhere, although the latter, as far as we know, had been proposed earlier, and was first employed in Germany. In 1642 the riding master Georg von Wahrendorff in the village of Luhe (or Luhre) in Upper Lusatia knew infusion and, like Ettmüller (22), Basilius Titelius (23) and Major (24), had it exercised on his hunting dogs, not infrequently, by one of his huntsmen. He sometimes injected them using his mouth from time to time, for a joke, with Spanish wine or brandy through a small chicken bone in a vein, and then connected them again: the dogs howled a little and got drunk until they finally slept off their intoxication. In the same way he used to give medicine to sick dogs. Where Herr von Wahrendorff or his hunter had learned this art is not known, as there is no mention of it either in the cited writings or anywhere else; just as little can be discovered of any noticeable influence of these attempts on the further fate of infusion, and they are therefore almost completely isolated.

The first regular, coherent processing of transfusion and infusion, the first systematic attempts to do so, which, moreover, are characterized by reliability and accuracy, (for most of them have the authority of the famous Philosophical Society for themselves, at their behest, or under its supervision) we owe to the English, and for this reason I am placing them here in the present section. Unmistakable is the influence that the research spirit, excellently awakened by Harvey, Boyle and others, had on these experiments and I hope my readers will happily linger with me while telling them.

HISTORY OF TRANSFUSION AND INFUSION IN ENGLAND FROM 1656 UNTIL THE END OF 1667

§. 9
It was settled that as early as 1638 the then famous theologian Potter, prompted by Harvey's discovery, suggested attempts at transfusion of blood to several members of the Philosophical Society and other scholars (25), (a suggestion which, however, had no effect); so the year 1656 is the first which in England became remarkable for our history. Towards the end of this year, the famous mathematician and architect Christopher Wren, at Oxford, invented infusion and also practiced it on a large dog. In the same year he informed the famous Robert Boyle, Doctor Wilkins and his other friends of this invention and his experiments, and described the apparatus used for it, which consisted of a syringe or a fine tube with a bladder attached to it (26). This gave rise to the following experiments, the recording of which we owe to Boyle, and which, as far as I know, are the only ones made by Wren, of which more precise information has come to posterity.

§. 10
The famous and tireless naturalist Boyle had scarcely received the above news from his friend Wren than he wished to convince himself of this subject so worthy of his attention by his own opinion. He therefore invited Wren, several doctors, and other persons, as his assistants or as spectators, to try the effect of dissolving opium on a large dog. Wren opened the dog's femoral vein (27) and injected a small quantity of a lukewarm solution of opium in Spanish wine into his veins (28). The dog's resistance and restlessness meant that part of the fluid which was to be injected into

it was lost. Immediately after the injection, the dog was untied and put on its feet; he staggered back and forth, shook his head, passed out, and fell into such stupor that one did not believe he would get away with it. Against all odds, however, he soon regained new strength and cheerfulness, as he was buoyed by blows and forced to continue running around in a neighbouring garden. Afterwards he was perfectly well, and with good care he became noticeably fatter. Boyle lost him soon afterwards by theft (29).

Wren, in Boyle's and the Marquis of Dorchester's presence, injected another dog with a massive does of *Crocus metallorum* by means of a small tube with an attached bladder, which he preferred to the usual spray, without producing any appreciable effect. As he injected two ounces and more, the most violent movements and such vomiting arose that after a few hours it caused death (29).

Boyle concluded from this unfortunate success that one should not use such violently acting agents for the infusion attempts, but should rather keep to *Cordialia, Antidota and Alterantia*.

At the same time he remembers that a shrewd doctor and anatomist told him of happy experiments which he had made with diuretics injected into veins.

§. 11

Early on, in England, people dared to administer infusion to people, because in the same year in which the above experiments were made on animals, or in the following year, the sensation they aroused caused a gentleman of Bourdeaux, who was then the ambassador of the French court in London, that out of curiosity, or for a nobler motive, he gave one of his servants who had been condemned to the gallows for a crime, for an experiment (30). In the presence of the envoy and of Mr. Colladon, knight and personal physician of the married queen, this unfortunate man was to have a wine made from *Crocus mettallorum* injected into the veins (31). But no sooner was any of it brought into the blood than either a real or a disguised fainting overcame him, which prevented the completion of the experiment. The only thing the poor criminal learned about the drug he had brought up was abdominal pain, which Boyle, however, considers to be the result of the fear he has endured (32).

§. 12

Among those to whom Wren made his infusion experiments known in 1657 was Timotheus Clarke, who would later become the Royal Medic, who was then studying medicine at Oxford. He and Boyle were just then engaged in an investigation into the nature and properties of blood; so one can easily imagine that he did not neglect infusion, which must have seemed important to him and because of the information it promised to give him in the above investigation. He not only injected water, but all sorts of beer, milk, whey, broth, and wine (some of these liquids sometimes up to two pounds) into the veins of animals, and set up infusion and transfusion of blood from one animal to another by means of a syringe but he even undertook an actual transfusion in 1664 using a tube curved at both ends (33). The latter attempt was just as unsuccessful as it was to Dr. Henshaw, who, according to Clarke's testimony, had dared to do it at about this time or a little earlier. For more than ten years, Clarke continued his infusion experiments not only with the liquids listed, but also with emetics and purges, opiates, cardiac tonic and diuretic agents. How much it is not to be regretted that nothing of all these attempts has reached posterity. It is true that he promised, as he was reading a report to the Philosophical Society in 1663, that they asked if he would have it printed; but as he made even more experiments in order to be even more certain of his cause, many phenomena appeared to him which made him very doubtful whether infusions could ever be used to cure diseases. Partly these doubts, partly also his frequent sickness and the amount of his other business

dealings, it seems, are to blame that at least as far as I know, despite the repeated requests of the Philosophical Society, he never put his experiments into print. Just as little as he believes that any substance brought into the blood can be wholesome if it has not first been altered by digestion, he is convinced of the benefit that infusion can provide for anatomy and physiology. He considers transfusion to be applicable in large and sudden blood loss. This is his opinion, and he gives us the above information in a letter to Oldenburg (34) in which he, at the same time defends the claims of his nation for the invention of infusion and transfusion, against the allegations of French and Germans. Among the latter, he says, Professor Major claims to be the inventor of the same, but he probably got to know about infusion from Count Palatine Ruprecht, in whose presence he (Clarke) tried infusions at the English court.

§. 13

In the Philosophical Society, infusion was first performed on 16th September 1663 in a public meeting. On that day, Clarke read out the above-mentioned report of his infusion attempts. He received approval and encouragement. The opinions of the members as to the usefulness of this operation were divided; some expelled them entirely from the field of practical medicine to that of anatomy, where with their help one could discover new vessels. Others judged that the injection of such things, which did not first experience digestion, could be harmful; but it would be different if things were prepared from animal substances, e.g. deer horn or urine spirit, taken in addition.

Various members suggested transferring the blood from a young dog to an old one (35).

§. 14

The following year was, if not empty of attempts, but at least of those from which news has reached us. It was not until 1665 do we read of a pair of infusion attempts which were made on 16th May in front of the Philosophical Society on two dogs with Florentine tobacco oil (36). One dog remained unchanged after the operation, probably because the dose of the poison was too small; the other, however, to whom 8 or 9 drops had been placed in his veins, became very sick and vomited. Gradually, however, he recovered.

§. 15

In order to promote infusion attempts, the Philosophical Society (Birch, I. c. II. p. 30.) had already made an offer to Clarke in the previous month of this year that all attempts, for which he would suggest the plan, should be allowed to be carried out by its members; it paid equal attention to transfusion, repeatedly resolving that it should be employed in a meeting, and by asking some of its most active members to register attempts to examine transfusion. It was the doctors Wilkins, Daniel Coxe, Thomas Coxe and Hook who were called upon by name. (Birch, vol. II, p. 50) As for the actual transfusion, the efforts of these gentlemen were no less in vain than those of Clarke and Henshaw, and they succeeded no better than the famous Boyle; then Lower, of which we will speak in the next paragraph, showed them the way to perform it (see Birch, II. p. 67, 85); on the other hand, a few experiments were made in which blood had been exchanged by means of infusion. Thomas Coxe drew the blood of a pigeon until it seemed almost dead, whereupon he injected the blood of another pigeon back into it and thereby kept it alive for half an hour. After this time, however, it died just like the other, through whose blood they had sought to keep it alive, but a long time later than that (37). A similar experiment was made on a dog

which had two ounces of blood from another dog injected into the femoral vein by means of a bladder with a tube attached to it. He did not experience the slightest serious consequences from it (38).

§. 16

The famous anatomist and physiologist Richard Lower deserves an excellent distinction in the history of transfusion as the first to practice it with great success on animals. In his case, too, infusion preceded transfusion. For at the time, just as Wren, Clarke, and Boyle were experimenting with it at Oxford, he too was attempting infusions with opiates, emetics, and other similar drugs on animals, but unfortunately nothing about them has reached us. He recorded some information in his book de Corde, but only of the two following experiments, made in physiological terms.

In order to make an attempt to find out whether or not the old doctrine, which he had questioned, about the ebullition of blood in the heart being the cause of its movement, was tenable or not; he resolved to investigate the extent to which, after emptied of blood, another fluid put in its place, which is less capable of this ebullition could maintain the movement of the heart. With this intention he withdrew almost half of the blood mass of a dog from the jugular vein and, on the other hand, gradually injected an equal quantity of beer, to which he had added a little wine, into the femoral vein. He repeated this alternately until, instead of the blood, only a pale liquid emerged from the vein, which looked like the water in which meat is washed (*loturae carnium*) or a claret wine diluted with lots of water. The heart left just a little bit in the beat it had before (39) so that the dog did not die until almost all of its blood mass was converted into beer (40).

His second attempt was as follows: he drew half a pound of blood from a smaller bull dog and, after having made room for the milk by this bloodletting, injected an equal quantity of fresh moderately warmed milk into his femoral vein. Scarcely had half an hour elapsed when the dog was overcome with anxiety and unrest; the diaphragm worked with the greatest effort; there were frequent palpitations, tremors, deep moans and howls, and finally death from a faint. He opened the dog and found both heart chambers, the pulmonary vessels and aorta, full of milk and blood, which had coagulated so much that you couldn't separate them well with your finger. Lower concluded from these latter experiments that in the plague, where similar symptoms are shown, a similar coagulation of the blood by the plague poison took place.

§. 17

Lower remarked in his various attempts at injection that the animals tolerated the injected beer, as well as the wine, quite well (41): this gave rise to the thought that one animal would be no less able to absorb the blood of another. In order to decide this through experiments, the usual route of infusion did not seem to him appropriate because of the inevitable coagulation and unnatural changes in the blood; he therefore undertook to exchange the blood directly from one vessel into the other.

At first he tried to transfer the blood from a jugular vein into the jugular vein of another animal; but since he saw the blood coagulate easily in the tubes because of its slower course, he chose the way that nature showed him to a certain extent, namely to make the blood flow from an artery into a vein. In the presence of Doctors Wallis, Thomas Millington and other doctors, at the end of February 1666, at Oxford, he opened the jugular vein of a moderate sized dog and let the blood flow out until it became faint and was on the verge of convulsions; thereupon he conducted blood from the *arteria cervicali* of a larger mastiff, which had been tied up next to it, into the opened vein until one could see from his restlessness and oppression that it was overflowing with blood. He then stopped the flow of the foreign blood flowing in, and let some blood flow out of the vein. He repeated this alternating tapping and draining

of the blood until two great mastiffs had gradually all given the smaller dog their blood and bled to death, and Lower's intention to exchange the whole mass of blood was fully achieved. The wound of the smaller dog was then united with a sewing needle and tied off. Although he had gradually lost and received as much blood as his own weight, he jumped down from the table at once, flattered his master, and rolled in the grass to cleanse himself of the blood, no differently than whether they'd just thrown him into the water (42). Subsequently, the experiment did not have the slightest negative impact on his well-being.

§. 18

At about the same time that Lower was making this curious attempt at Oxford, the Commission appointed by the Philosophical Society, in conjunction with Boyle, at London, undertook new transfusion attempts; but the imperfection of the instruments, as Boyle complains in the report read to the Society on 18th April 1666, prevented its success this time as well. At the same time, however, he stated that he hadn't given up hope of better future success (43).

In the same session Boyle also said that he had tried to feed a dog with meat broth injected into the jugular vein, but the outcome was the same as the first injection, death, perhaps because he had brought the broth into the blood too suddenly or in too large a quantity. He found the right ventricle of the heart full of broth when the dog was opened. In similar attempts the femoral vein is preferred to the jugular vein because of its greater distance from the heart (44).

Doctor Charleton, too, reported to the Society that day that he had injected purge remedies into the veins of animals without success, but emetics and opiates had very rapid effects (45).

§. 19

Not long afterwards, the Philosophical Society received news of Lower's successful transfusion attempt through Doctor Walis. The ultimate success of a cause so often undertaken in vain was heard with no little joy by most of the members of the Society. Robert Boyle has now been commissioned by the Society to ask Lower for a precise description of his transfusion method (46). Boyle therefore wrote to Lower on 26th June, presenting the Society's request to him. Lower's reply of 6th July was only submitted to the Society and entered in its register on 26th September. (47) His method of performing the transfusion described in this letter is as follows:

Loosen the carotid, about a finger long, from the animal which is to give the blood, separate the nerves of the eighth pair from it, and tie it tightly towards the head with a knot. Half a finger from this ligature, put another thread towards the heart, but only tie it with a loop. Between these ligatures the artery is opened, a tube closed with a stopper is brought into it toward the heart, and it is tied in it. In order that this tube and the vein remain warm during the dissection of the other animal, the skin is kept as much as possible pulled together over the wound. In the animal intended to receive the blood, the jugular vein is exposed for half a finger and two ligatures with loops are attached to it. Between these two loops one opens the vein and ties two tubes closed with stoppers in it, one of which, directed towards the head, is intended to drain its own blood, the other directed towards the heart, to receive the foreign blood. The two dogs are then tied next to each other in such a way that neither the artery nor the vein are tensed at the union, the tube of the artery is united with that of the vein through a third tube attached between the two, and the loops are loosened so that free blood overflows from the artery into the vein. From the opened tube in the vein, which is directed towards the head, blood is allowed to run as much as is considered necessary to make room for the new blood. After the experiment has been completed, both ligatures are tied firmly to the vein, cut the veins from one

another, and unite the skin wound through the bloody nath [sic]. In order to make the transfusion easier, he advises that a flexible canal prepared from the *arteria cervicali* of an ox or horse should be used for the third tube through which the other two are connected. As for the tubes which are tied into the artery and vein, it is best, instead of a quill or any other straight tube, to take a somewhat curved, fine silver tube with a protruding bulge or rim at the end which is inserted so that it can be tied better into the vein (48).

Lower considers transfusions to be of great use for the maintenance of the sick, exhausted by great blood flows; perhaps one could also create benefits for insane people and arthritics, whose intestines are healthy and whose juices are not infected by putrefaction, by drawing off the old blood and communicating a new one. But all sick people whose blood is spoiled by putrefaction or a contagion added from outside, or who suffered from disrupted intestines infected by pathological substances (such as, for example, in scurvy, lust and leprosy, putrid and chronic diseases), should not expect anything from transfusion, for the blood and the unclean entrails would very soon inform the new blood of their spoilage, not other than, like an unclean, mouldy barrel, the smell and spoilage of the poured wine. Incidentally, there is no reason whatsoever to worry that the nature of an animal would be changed by foreign blood (49).

At the very place where Lower expresses his judgment on the transfusion, he adds a defence of the rights of his countrymen to the invention of this operation against the claims of the French, and some suggestions for attempts at transfusion.

§. 20

The Philosophical Society immediately appointed a commission to investigate transfusion. Daniel and Thomas Coxe, Dr. King and Hook were asked to attempt transfusions, first for themselves, and if they were successful, then publicly before the Society. To this end, they were given Lower's description of his transfusion method. Doctors Goddard, Merret, Clarke, Croune, and Balle were asked to be present in these experiments (50).

In one of the following meetings Robert Boyle presented the Society with a number of physiological problems which he expected to be resolved by transfusion and infusion experiments.

He wished to see determined by them: whether a dog's disposition could be changed by foreign blood? Whether for example, the blood of a timid dog made another fearful? Would he know his master again after such an operation and not have forgotten the arts he had learned before? Whether his skills, e.g. its pungent smell, will remain unchanged? How his pulse, urine, evacuations, etc., behaved according to the same? Would it be possible to better satiate by transfusing a dog that was previously well fed into a hungry one, the latter by the many chyle in the blood of the former than by other blood transfused into it? Is it possible to sustain life by simply repeating transfusions from time to time? Whether one can cure by transfusion diseases in which the blood is believed to be affected, and on the other hand, communicate disease to a healthy animal through such sick blood? Would it be possible to rejuvenate old animals and make old ones young? Can you make a dog bigger than it would normally be? Whether the colour of his hair would change, and whether one could transform one animal into another of different kinds by frequent transfusions? What, he continues, will happen if the blood of an animal is passed into the veins of an animal of a different kind, e.g. if one gives the blood of a sheep to a dog, the blood of a turtle or a fish to any warm-blooded animal? How will the drugs injected into the blood behave and how will they work? Will a dog be purged from another's blood that has been passed into it and to whom a purge had previously been administered? What will happen to the young if the transfusion is given to a pregnant bitch?

At the same time Boyle added the reminder that, in order to determine the amount of transfused blood, both animals must be weighed before and after the operation (51).

§. 21

After repeated requests (52) the scholars appointed by the Society finally undertook on 5th November following, a transfusion, according to Lower's method (see p. 19.) in the house of Dr. Pope. They tapped the blood of one sheep from the jugular vein, and at the same time let the blood of another sheep flow from the carotid into the lower part of the jugular vein. After about four or five pots (pints) of blood had flowed out of the vein, the sheep, whose blood was poured into the other, began to faint. It was untied and its owner slaughtered it in the usual way. There was no more than half a pot of blood in it. The other sheep seemed to be as good as before, and behaved no differently than if no such attempt had been made with it. As it was slaughtered, the usual amount of blood was found in it (53).

The small tubes tied in the veins, which were used in this experiment, were made of copper; the central connecting tube was made of quills.

§. 22

After this attempt had succeeded so well, the committee appointed for it ventured a few days later, as it had requested, to appear with a similar attempt at a public meeting of the society. Dr. Thomas Coxe and King performed the operation. As in the previous experiments, they passed the blood of a little bull dog into a spaniel, and while this foreign blood was overflowing, the spaniel's own blood flowed out. The latter was forgotten until the bull dog had bled to death for sixty-four ounces of blood, without harm to his health; on the contrary, he was very happy and cheerful the following morning, and stayed that way. A week later King showed him when reading his report of this operation to the Philosophical Society, which found him completely well (54).

In this and the following meeting, the Society again decided to continue transfusion attempts with care; it wanted first to attempt to draw blood from a sheep into a bull dog, and then from a healthy young dog into an old and sick dog, from a mangy dog into another healthy one, from a young horse into an old one, and finally to see a healthy ox or cow into a sick horse (55). For the experiment to be carried out on a dog and a sheep in the next session, Messrs. Coxe and Hook and Doctors King and Pope were appointed as curators, and they were at the same time instructed to undertake the experiment on their own first (56).

§. 23

This transfusion between such diverse animals was actually made on the 7th or 8th December by Dr. King, in the presence of Messrs. Daniel and Thomas Coxe, Oldenburg, and Hook, and Dr. Pope, employed with the happiest success. The dog they poured the blood of a sheep into was doing pretty well after it.

In the same way the drawing of sheep's blood carried out on 12th December in a sheepdog (a kind of mongrel) in the presence of the Society succeeded. But the cold weather made the blood to clot, which made the operation not proceed as easily as the previous one (57).

As the first attempt to be made, the Society determined the transfusion from a mangy dog into a healthy one, and the procurement of the same was given to Mr. Daniel and the gentlemen Thomas Coxe, Hook and Dr. Balls. Boyle reminded him that one should not fail to weigh the animals before the operation.

In a subsequent society meeting, Dr. Pope suggests draining half of its blood from a dog, and instead of warm milk, because it can curdle, injecting warm barley gruel (barley cream). Boyle remarked very correctly that in these experiments one must not only take into account the nature of the liquid, but also the manner in which it is injected. One must be careful that it does not drive the blood to the heart in too great a quantity, and by sudden excessive stretching of it, kills the animal; therefore it is best to inject slowly and into a vein further away from the heart (58).

§. 24

The transfusion method first attempted by Lower, in which the blood is passed from the vein of one animal into the vein of the other, but which he rejected because of the easier coagulation of the blood in the tubes, was used by Dr. King, because of some of the advantages that it seemed to have before the more common transfusion from an artery into a vein, drawn out anew, and successfully applied several times.

The first successful attempt was made by Thomas Coxe when the transfusion decided by the Society was carried out from a mangy dog into a healthy one. He took a very agile old farmer dog, of moderate size, and diverted the blood from its jugular vein into the jugular vein of an almost equally large healthy Wachtelhund [German spaniel] dog.

In order to make the blood flow properly, one had to compress the other side of the neck with a cord tied around it, as much as one could do without interrupting the respiration. From the upper part of the vein of the healthy dog about 14 or 16 ounces of blood flowed out during the experiment, and just as much, according to Coxe, flowed into him from the vein of the mangy dog. This transfusion caused no change in the healthy dog, but the mangy dog was completely cleared of its mange in 10 to 14 days due to the loss of blood or the better care he received after this experiment.

The society decided to undertake a new transfusion attempt at the next meeting, which was entrusted to Dr. King. He was supposed to withdraw the greater part of its blood from a dog without, as in the previous attempts, at the same time infusing it with new blood, and only after this profuse bleeding should refill it with the blood of a lamb (59).

§. 25

According to this, King drained fifteen ounces of blood from a spaniel and, as had been done, passed at least seventeen ounces (60) of blood from a sheep into him, as he calculated by means of a second clock, according to the time of the overflow of the blood, which had lasted four minutes; for just as the sheep was then made to bleed afterwards into nine bowls, so the blood that had leaked out in eight minutes weighed thirty-six ounces, and yet it can be assumed that it flowed more slowly during this time than it did during the four minutes it did when it overflowed into the dog (61).

The society asked Dr. King at the next meeting to submit a detailed report of this experiment. I do not know whether this has happened; the same is found neither in *Birche's History* nor in the Philosophical Transactions, and I am therefore unable to give more than the above [report] of this transfusion, which affects us both in the subject of the method used (whether from an artery to a vein, or from a vein to a vein) as well as it leaves us in doubt in respect to its success.

§. 26

In his home, Dr. King, with the help of some of his friends, attempted the following experiment: he let forty-nine ounces of blood flow out of the jugular vein of a sheep until it became very weak and the blood flowed out very slowly. He then stopped the

bleeding, and from the jugular vein of a calf, through the usual tubes, allowed the blood to flow over for five minutes. In order to be able to estimate to some extent how much blood would overflow in a given time, he had previously let the calf bleed from the jugular vein into a bowl for 40 seconds, and during this time obtained ten ounces of blood. Since King concluded from this that the sheep had received almost as much blood again in the five minutes that the actual transfusion lasted as was withdrawn from him, he closed the vein and untied it. It had its full powers as before and went about as it was put on the earth. The calf's blood was already beginning to clot in the vein; one of the carotids was then opened, and from it only 25 ounces of blood were obtained until it died.

Since they wanted to slaughter the sheep too, after a while the vein was opened; after losing about 60 ounces of blood it convulsed, and after losing another five ounces it died (62).

§. 27

King also tried infusion, which at this time seemed almost forgotten because of transfusion. Indeed, perhaps through the suggestion of Dr. Pope (p. 23) who injected eighteen ounces of milk in which sugar was dissolved, into the veins of a dog from which he had previously drained an equal quantity of blood. The Philosophical Society asked Dr. King for the details of this attempt. He actually submitted a report about the same on 18th April, of which however, nothing can be found in Birch except that the dog stank before his death. From this, one can at least conclude that it must have survived the injection of such a large quantity of a strange liquid for a long time until putrefaction could finally develop in the wound or elsewhere in the body (63).

§. 28

In accordance with the wish of the Society, that the attempt of s. 26 be repeated, but wanted the sheep to be kept alive after the blood had been tapped, Dr. King bled a smaller sheep until, after a blood loss of more than forty-five ounces, it fell into a state of extreme weakness, and seemed lost without salvation. He then passed the blood from the vein of a large calf into the sheep for seven minutes, so that according to his calculations it received more blood than it had lost (64). When it was untied after the attempt, it was so courageous that on the spot it very forcibly attacked a dog, which happened to be present and which King had poured sheep's blood into.

It was then sent to the pasture in the grass; she was perfectly well for three weeks, but then fell ill (*pined away*), and died (65).

§. 29

At the meeting of 11th April, Sir George Ent proposed the suggestion of trying to resuscitate dogs that have nearly bled to death with the blood of other dogs. His suggestion was accepted, and orders were given that dogs should be kept ready; the execution of the same was suspended however, I do not know why, and instead, on the second of May of this year, Dr. King made another attempt which was perhaps thought to be more interesting, namely the transfusion from a dog or fox into a sheep or lamb (66).

According to this, King let a sheep bleed until it became weak, and then transferred the blood of a dog into the same until, according to his calculations, it had received as much and more blood as it had drained, and until it seemed extremely ill. He then put it on its feet, but it did not want to stand, but lay down and was in such fright (*agony*) that one feared it would die. As it was concluded from the violent sobbing (*clapping of the diaphragm*) that it had received too much blood from the dog, ten to twelve ounces were drained from it, whereupon the sobbing subsided and

breathing became much easier; but the animal was still ill for two or three hours. The next morning it was bearable and ate hay. When it was sent to the pasture, it ate, and seemed to be well for 6 to 7 days, but it did not stick to the rest of the flock; but after three or four days more it died. The wound on the neck was found, because it was neglected, badly bruised by the heat of the weather and the injuries of the flies. The blood which it had received from the dog was partly venous and partly arterial. First, namely, one transfused from the jugular vein, but with many complaints, because since the dog had lost one jugular vein in another attempt two days before this attempt, the ligature and cutting of the other vein put him in such a state that one feared he would die before the sheep was ready to receive the blood. For a long time the blood flowed freely from the vein into the sheep, but then, as King thinks, because of its prolonged stay and stagnation in the veins before the transfusion, it became so inclined to clot that an artery was opened and the transfusion completed from this (67).

§. 30

Ten days later, Dr. King performed the following strange transfusion in Boyle's presence: he let blood drain from the vein of a very small and poor fox, which had been prepared for transfusion, and only five ounces because of his leanness, and then tapped the blood of a lamb into him for so over long until he became very short of breath (68), and King, out of concern that he might asphyxiate, interrupted the flow of blood from the lamb. Since he was still just as short of breath, King let four ounces more of blood flow out of him, which was now much redder than before it was mixed with the blood of the sheep. After this loss of blood he seemed weaker than before: blood was poured into him again from the lamb until he was believed incapable of receiving more without danger. Nevertheless he continued to be very ill, was shy as before, and abandoned his usual food and drink; but he barked, and with great anger snapped into a stick that was held in front of him. After twenty-four hours he trembled, weakened, and died. After he died, some blood flowed from his nose. His chest and abdomen were found half full of bloody water, or rather blood; all the vessels were very dilated, and the skins of the intestines appeared to be inflamed.

As to the cause of his death, King raises the following questions: 1) Did the lamb's blood change the properties and consistency of the blood from the fox so that it became thinner, and consequently the spirits could fly away more easily, and on this depended the weakened tone of the fox’s vessels?, or 2) couldn't the arteries get rid of their blood because the overcrowded veins weren't able to hold more blood?, and 3) perhaps this excessive expansion of the arteries and veins deprived their membranes of their density and strength, and hence the fatal leakage of blood?

The second question seemed to him the most probable (69).

§. 31

At about this time the famous Mayow must have made that interesting transfusion attempt that Dr. Beddoes tells. Mayow transferred the arterial blood of another animal (which is not given) into a groaning, deeply breathing dog; immediately as arterial (i.e., more oxidized) blood came into his veins, he began to take breath so calmly that it was hard to notice it, because here he was consuming the substance of the violent muscle movements from another unusual source, and consequently did not need to inhale so much air to obtain it (70).

All my efforts, however, to find this attempt in Mayow's writings, were in vain; Dr. Yeats (71), complains about this, and Dr. Scherer, who, as I had one of my friends question him about it, was busy editing Mayow's writings, also assured me that he was unaware of this attempt. So probably Dr. Beddoes was misled by his memory in citing it, if he did not take it from Mayow's unknown writings; for I cannot believe that

he, like Girtanner and other literary freebooters, allowed himself an intentionally fake citation. But even if Mayow did not have the idea of letting one animal breathe through the other, it is at least found in Dr. Croune, as I will continue to cite. I am not aware of any attempt made with this aim in mind.

§. 32
At their meeting on October 1667 the Philosophical Society decided, from a physiological point of view, a peculiar transfusion in which the blood of a dog was to be conveyed by means of a tube from the pulmonary pulse artery (vena arteriosa) into the aorta without letting it circulate through the lungs. Dr. Lower and Hook were assigned to do this. On 4th November 1667 Dr. Hook made this attempt, but it was unsuccessful, but he had already thought of a new and better method. However, as he reported to the Society on 28th November, he did not succeed in this new attempt either, not as desired, but without giving up hope of better success because of it. Afterwards, however, we hear nothing more about it,

With better success Lower transferred the blood of a dog from the carotid directly into its jugular vein on the same side, as he reported to the Society on 4th November. While the blood ran this new path, the dog was fine. The Society expressed the wish to see this attempt repeated in a public meeting. I do not know whether this happened; there is nothing about it in Birch.

Now the plan of our history given in the preface requires that we turn for a time from England to the French.

HISTORY OF TRANSFUSION AND INFUSION AMONG THE FRENCH FROM 1657 TO 1673

§. 33
For more than ten years the most famous naturalists of that time in England had continued with transfusions and infusions by way of quiet testing through careful experiments on animals; when at last the French began to take notice of this subject. They soon seized it with all the vivacity of their spirit, and had the courage to also practice transfusion on people, which other nations had hitherto shied away from doing. Her bold attempts brought transfusion up quickly, but made it decline again just as quickly; to which, on the one hand, the carelessness and exaggerated hopes of the friends of this operation, and on the other, perhaps the low cabals of opponents contributed equally as much.

The real history of these operations in France does not begin until 1667, but we have to go back a little further because the French name a couple of their compatriots as inventors of them. These are the Abbé Bourdelot, Dr. of medicine and first physician of Queen Christine of Sweden, and the Benedictine monk Robert de Gabets.

The lieutenant von Gurye in 1667, in his *Lettre à Mr. l'Abbé Bourdelot*, lists the former as the inventor of the transfusion, without knowing it or wanting to know that this operation had been in Germany long before and later also suggested in England, and that the infusion of Wren was actually practiced a year earlier than Bourdelot dated his invention of transfusion. More than ten years ago, i.e. around 1657, Bourdelot claims, according to Gurye's testimony, to have proposed a transfusion to Herr von Montmor, how he had just returned from a trip to see a distinguished patient. “All the blood of this patient,” says Bourdelot on the beginning. Places, “was so burned, thick and black that it looked like bad luck. With twenty-eight bloodletting, lots of good bouillons, jellies, and moisturizing foods, I was able to improve his blood

mass in eighteen months. By introducing the blood of young animals directly into the veins, I would probably have been able to cure it in a month. This method, sick people whose blood is too thick and salted be improved by alterantia; to help, it occurred to me at Arcetri during a conversation I had there with Galileo about the injection of various purifying, altering, and restoring fluids. If paralysis can be cured by inserting the ailing part into a slaughtered animal that is still warm, the injected blood must be even more effective." Dr. Bourdelot then made a number of experiments which are entirely worthy of his pathological theory; for he poured some salt solutions and spirits on the evacuations of the sick, in order to deduce from the change in colour the effects which their injection into the veins would presumably have. After these clean attempts he let it go.

§. 34

The claims of the Benedictine Robert de Gabets to the invention of transfusion are somewhat better founded, which Professor Denis ascribes to him in his *Lettre à Mr. Sorbiere, etc.*, in 1668, and which he is said to have presented in July 1658 in the Society of Sciences to Mr. von Montmor. Gabets told in a lecture there how Harvey's discovery had brought him to a new way of circulating blood, namely the communicative one, from one animal to another. To practice it, one needs nothing more than two small silver tubes, one of which with a trumpet-shaped mouth to receive the blood is placed on the open vein of one animal, the other smaller one however, would be inserted into a vein of the animal or man to whom blood is to be imparted. These two tubes are connected by a third tube, which, however, must not consist of inflexible metal, but of a small leather tube, which, besides other advantages, also allows the blood to flow through by alternating the pressure with the finger to what end two valves would have to be attached to the ends of this tube to prevent the blood from receding during the pressure. This enables the surgeon at the same time to determine the amount of blood transferred. The blood is passed over in this way without being changed by the entry of air, and it can be prevented from cooling by means of warm cloths placed on the tubes. The practice of this operation is therefore not at all dangerous, least of all if the blood mass is not exchanged all at once, but only partially with new blood. There are several reasons (which I will pass over here) that there should be no disadvantage to the difference in complexions. Transfusion would be of great benefit in the event of exhaustion from bleeding, illness or age (in which latter case one must first draw off the bad blood); also in diseases of bad condition or lack of blood, in which the bowels themselves would not have suffered; for example, in the beginning of dropsy. The animals for this could be chosen carefully and prepared by a suitable regime. Likewise one could perhaps with advantage bring medicine directly into the veins, the strength of which would be weakened in the normal way.

Gabets was deterred from carrying out these proposals by the little approval which these proposals found in Montmor's learned society, and by the mockery which he thought he saw from some of those present, but he continued to talk to his friends from time to time about this subject, and tried, albeit in vain, to persuade a surgeon to attempt transfusion. Three years later he had the instruments described above made for him, but never used them, and thought so little about his invention that he did not appear publicly with them until in Denis' letters in 1668.

§. 35

For all that Gabets claims have been said and done about transfusion, it was not until 1667 before the period of more active processing of this operation began in France. Jean Denis (72), professor of philosophy and mathematics and subsequently also professor of medicine, so famous in the history of the same, opened this period, and

played in it with his warm zeal for transfusion (73), with his skilful experiments in people, and because of the fury with which the opponents of the transfusion attacked him, continues to play a most excellent role.

For his first transfusion attempt, gave him, as described in his *Lettre à Mr ... touchant la transf. du sang*, narrated the hope of being able to resolve some doubts about the circulation of the blood, to resolve the issue. This consisted in the fact that he, on 3rd March 1667, in conjunction with a skilled surgeon Mr. Emmerez, (who seems to be the main character in this transfusion as well as Denis, as far as the operative part is concerned), took the blood of a 12-inch-high female Spaniel from her femoral artery (which he preferred to the carotid, because it is easier to bare and its ligation does not so easily result in convulsions), into the jugular vein of a two inches smaller Spitz ('a dog resembling a fox'). The instruments which he used for this purpose were two small tubes of brass, 1½ inches long, curved at their ends, which were tied into the veins, and then united. During the operation, the blood of the receiving dog was drained into a bowl from the upper part of the vein, into which a tube had been tied in order to better collect the blood. The same flowed from the time that arterial blood was passed into the animal, far more intensely than before. After nine ounces had drained off (a considerable amount for such a small animal), the bitch that gave the blood began to faint; therefore, because they wanted to keep it alive, they stopped the vein and set it free. She was so weak that she hardly had the strength to crawl into a corner of the room (74); the other dog, on the other hand, was well and powerful, only a little sad, which Denis believed he could rightly attribute to the pain of the wound, since another dog, whose skin over the vein had only been cut open to keep it in reserve, but without doing the transfusion on him, was even more depressed. As proof that the blood did not stagnate in them while the tubes were united, but actually overflowed, Denis cites that the recipient dog's vein pulsed continuously like an artery during the experiment, and that how the tubes were kept pulsing pulled apart, the blood had flown freely from them.

Soon afterwards Denis and Emmerez repeated this experiment on two other dogs, and they succeeded even better than the previous one, because they were now more practiced and the room in which they were operating had been warmed up beforehand. The blood-giving dog seemed dead after 12½ ounces had drained off, and its blood stopped flowing; by pouring wine in his mouth, however, he regained consciousness and was sustained with good care. The blood-receiving dog (the same one who was so depressed by the mere skin incision in the previous attempts) was now very well after the transfusion, he was caressing his master, and a half hour later he ate food.

His next transfusion attempts were made by Denis and his assistant on three dogs, which he fed calf's blood. One of these dogs, from which he had drained so much blood away days beforehand, that he could hardly move, received new strength and liveliness from the calf's blood, even more than he had before the blood loss. The two other dogs did not suffer the slightest disadvantage from the transfusion (75). M. de Montmor honoured one of these attempts with his presence (76).

§. 36

Transfusion found its second declared patron and defender in France at the Doctor of Medicine and Professor of Surgery, Claudius Tardy, who did not make experiments himself, but at least spoke in a small script (77) for the same, and especially for their use on people, and for theoretical reasons which had an effect on his contemporaries who were able to prepare the public for the experiments that were subsequently actually made on people. Transfusion, he assures in his cited script, which he too can rightly claim to have discovered (he gives no evidence for this assertion), can be more easily stated, considering that the life of the animals should rather be taken out

of the game, hiring people because they have more blood and are not so reluctant during the operation. It is true that the transfusion cannot be used in hot illnesses, in young and bilious people and the like, since the substances brought through the mouth are able to cool off far better than blood, which is by its nature hot; but in the case of old men, cachectic persons, apoplexies, tympanitis, dropsy, melancholy, rheumatism of the rose [rheumatoid arthritis] and canker, more can be expected of them. As veal broth is given in blood flows with benefit, since blood and meat are of the same consistency, veal blood flowed into the veins must provide the same assistance. In lienteria and dysentery and in general, where the intestines did not digest, transfusion could at least preserve strength and gain time for healing. With people it could be done on the feet placed in warm water, but still better on the hands. Transfusing from one person's artery into another's vein would be best if it were not so dangerous. At most one could add an artery of the thumb or a finger; it remains safer, however, to transfuse from one vein into the other. The only thing I can say of Tardy's transfusion method is that he has the veins exposed through an incision in the skin and that he uses curved, inflexible tubes for this purpose. If the superfluous blood of a person is not sufficient, he thinks, one could add two, three, and even several suitable subjects one after the other. If anyone in need of a transfusion does not have a skilled surgeon on hand, he only asks for help with them.

The injection of purgers seems to Tardy useful only in apoplectic patients who cannot swallow, by making the blood fluid, but in others because of the easily developing inflammation of the heart, and other dangerous viscera.

§. 37

Denis and his assistant now continued their transfusion attempts with zeal, now from an artery into a vein, now from a vein into a vein, on weak and strong, large and small dogs, as well as on those who had often given their own blood and received something foreign. He also transferred the blood of various kinds of animals into dogs, without any harmful effect. Out of ten dogs not one died from these attempts, rather he noticed something extraordinary in all those who had received new blood.

It is a pity that those cited above are the only ones of all these experiments of which a somewhat more detailed description has come down to us (78).

§. 38

As much as Denis felt himself convinced by these attempts that transfusion was nothing less than as dangerous as it is believed to be, he nevertheless wished to be secured by theoretical reasons before he dared attempt it on people. He therefore turned to the most skilful doctors and philosophers in Paris to hear their opinions on the transfusion. The objections that some of them made to him and the reasons with which he refutes them are as follows (79).

Some, says Denis, denied the possibility of transfusion at all, because; 1) the blood of different animals differs so much from one another that it must become a poison when it is brought into foreign veins; 2) Spilled blood spoils according to Hippocrates judgment; 3) in the lifeless canals of the transfusion apparatus, the blood must clot and, if it gets into the heart, cause fatal palpitations.

Denis, on the other hand, replies briefly: the strange blood will do as little harm as the flesh of strange animals which we enjoy; rather, the diverse nature of the blood affords the advantage that we can treat Contraria contrariis. Hippocrates' proposition applies only to blood that has come out of the veins, and numerous experiments on animals have shown that it does not clot in the transfusion tubes.

Others only objected to the use of transfusions on humans. They said:

1. The healthy blood will not mix with the sick one. Denis replied: that the circulation of blood and the movement of the heart are more than sufficient to bring about the union, as the following experiment confirms. Some time ago I injected about half a setier of milk into the veins of an animal, and found it, when I opened it some time later, so completely united with the blood that nowhere was the slightest trace of the white milk to be seen, and the blood was also there on the whole more fluid and less coagulable.
2. Objection: The new blood will immediately be made equal to the old in the great organ of blood preparation, the liver. Denis replies against this by giving reasons to deny the liver that ability.
3. Objection: The whole body can become so corrupted that the healthy blood brought into contact with it must spoil as quickly as good wine in a vessel in which there was vinegar. If the blood that has been poured in can affect the animal, why didn't that dog in England get the mange from the blood of a mangy dog? Denis: Such corruption can only take place in very few incurable diseases; how else could one be able to achieve something everywhere else by means of medicine and food, which are nevertheless exposed to corruption in the digestive tract, instead, the transfused blood escapes the opportunity to be spoiled. The sour wine cannot be improved, but just as one can improve the other bad properties of the wine by pouring some liquids into it, so too is a transfusion able to make a coarse blood finer, a too liquid one more solid, a too warm one colder and a too cold one warmer. The listed dog did not get the mange because it was only a skin disease. Perhaps his healthy blood tended towards the sick; maybe he really didn't stay as healthy as it seemed.

On the other hand, Denis continues, the following reasons for the transfusion are favourable:

1. Nature itself teaches it to us by feeding the fetus in the womb by a kind of transfusion through the umbilical vein. Do not object that mother and child should be regarded as one body; very often the male seed had the upper hand over the female, and the constitution of the fetus is very different from that of its mother.
2. The transfusion of blood is nothing but an abbreviated supply of food, for instead of eating food to replace the forces and to cool the heated parts, the good juices of which are only separated from the many impurities associated with them through digestion before they pass into the blood as a chyle, and are completely converted into blood in the heart, the transfusion brings an already completely worked blood directly into the veins,
3. Most physicians agree that the greatest number of diseases consist in the unnatural warmth and corruption of the blood, as evidenced by their most common method of healing, which consists in drawing the blood by bleeding and refreshing it with drinks. By draining the tainted blood, however, they often weaken them so much that exhaustion and dropsy are a result, and a party among them is nothing less than a lot of bloodletting. Through transfusion, these two different parties of physicians can now be united with one another, in that those who shy away from drawing off the spoiled blood because of exhaustion can now prevent it with fresh blood. Moreover, the improvement of the blood through transfusion is also preferable to that through beverages, because these are greatly changed by the ferments in the intestinal canal, or also weaken the intestinal canal through their own ferments.

There is no doubt that the transfusion of mild, healthy blood in violent blood flows and the early age arising from lack of blood and warmth will be beneficial; perhaps also in pleurisy, peeling, ulcers, leprosy, cancer, rose [arthritis], madness and rage, and other diseases arising from the corruption of blood, as experience must teach us.

According to Denis, the blood of animals is preferable to that of humans for transfusion, in that:

1. Animals do not become sick through debauchery in eating and drinking and through passions.
2. Animals can be treated more brazenly, and their best blood, namely arterial blood, can be used for transfusion, which would be too dangerous for humans.
3. Animals can be more easily prepared for this use by choosing food. Finally,
4. If the milk and meat of some animals are so good for the sick and healthy, why shouldn't their blood be just as wholesome (80).

§. 39

For the reasons just given, performing a transfusion on a person must have seemed less dangerous to Professor Denis. Some of his friends asked him to urge the king to try this attempt on an offender who had been condemned to death; but the thought that in such a person's already existing fear of death and the apprehension of an operation that he would regard as a new kind of death penalty, could have a detrimental effect on the success of the transfusion, led Denis to wait for another opportunity. Both of these finally presented themselves to him by finding in a young fifteen or sixteen-year-old soporous person, a suitable and willing subject for transfusion (81). He had suffered for more than two months from a violent and persistent fever, in which the doctors had bled him over twenty times. Before this disease his mind and body were lively and active, and his memory very good; after this, however, his mind was numbed, his memory seemed completely lost, and he was so lazy and sleepy that he was no good. Denis saw him fall asleep even when he sat down at the table for breakfast and the like; after a sleep of nearly twelve hours he could hardly be driven out of bed in the morning, and he fell on the whole day in extreme dullness. According to Denis' conviction, the little blood remaining in the veins was very thickened by the heat of the fever, and therefore stagnated in the veins without being able to properly set the nerves and the vascular system in motion. In order to remedy this morbid condition, Denis drained about three ounces of blood from him on 15th June 1667 at 5 o'clock in the morning, which was so black and thick that it had difficulty running down into the bowl, and from the carotid of a lamb poured about three times as much blood back into his veins as had been drained. So that he would not be afraid of the operation, he had been left in ignorance of the nature of it, and had imagined that the sheep was only being held by his arm to suck out the unhealthy blood (82); his eyes were also closed (83). After completing the transfusion, Denis bandaged the vein like after a bloodletting, and let the patient lie in bed. During the operation he assured that he had felt a great warmth up the arm, was very much relieved, and at the same time that a pain in the side, which had arisen a few days before after a fall from a ten foot ladder. In order to examine the nature of his blood, half a cup of blood was allowed to drain off, and it was found to be somewhat more fluid and redder in colour (84). Around ten o'clock he asked to get up, which Denis, since he found him well and cheerful enough, allowed him. He was then busy doing his usual work for the rest of the day, as before, and looked cheerful and laughing. At four o'clock in the afternoon he lost three or four drops of blood from his nose, and Denis, after having had a good dinner, let him go to bed at nine o'clock. He fell asleep at ten o'clock, but woke up again at two o'clock after midnight, and, when he could not go back to sleep, got out of bed at four o'clock. Throughout the day his mind was much more alert and his body much more active than before. The following day he slept a little longer, but from then on he could easily control his sleep addiction, something he had often tried in vain before. From now on he would get up early in the morning without having to be woken up and would no longer have that dullness of mind and indolence of body

which made him incapable of anything. He became visibly fatter, and everyone who knew his previous state was amazed at the change.

Denis attributes the remarkably good success of this transfusion to fermentation and the resulting stronger development of spirits, which the arterial blood of the animal has brought about in the viscous blood of the patient (85).

§. 40

The happy failure [sic] of this first transfusion attempt on a person encouraged Denis to undertake a second attempt with an even more abundant transfusion on a person, for which a sturdy litter carrier of 45 years of age was willing for money. Since Denis had reason to suspect that his vessels were not very full of blood, he let him drain only about ten ounces of blood early in the morning, and once again conducted as much blood from the femoral artery of a lamb (which he preferred to the carotid as more convenient for transfusion) into him. Mr. Emmerez, as Denis boasts, performed this operation with such skill and care that it proceeded almost as quickly and painlessly as an ordinary bloodletting for the transfused person. During the whole operation he remained in his cheerful mood, laughingly made his remarks about this new healing method, which seemed strange to him, and said to Denis: from the opening in the vein to the armpit he felt a great warmth from the inflowing blood. After the operation was completed, Denis wanted him to behave calmly, but since he did not feel any change in his well-being, he was not deterred from slaughtering the lamb on the spot, inflating it and peeling off its skin, a business which he had done in his youth. Thereupon he asked to go home, where he promised Denis to remain calm, and enjoy a soup; but he was scarcely on the street when he went to his companions in order to eat with them in a pub using part of the money which had been given to him for his neglected daily wage. Since he felt unusually strong towards noon, whether it was because of the new blood he had received six hours ago or because of the wine he had drunk, he undertook hard work which required full physical strength and which would have been a problem even for a horse. Denis met him on the street the following day and reproached him for his carelessness; but he excused himself by saying that it was impossible for him to keep calm as long as he was well, and this was the case with him in the highest degree after the operation. He even assured him that he felt stronger than before, and bathed Denis [sic], if one wanted to repeat the matter, one would not want to take anyone else, like him, then he would also keep calm and punctually do what would be prescribed to him (86).

§. 41

The surgical method followed by Denis and Emmerez in these and the following transfusions is, according to Denis's own letter to Dr. Soribiere, the following: For transfusing people, two silver, rather fine tubes, two inches long and only one line [1/12th inch] in diameter are used, which are curved at the ends that are inserted into the veins, and lightly at the two other ends and fit exactly into each other. In the animal which is to give blood, the crural artery or carotid is exposed (the blood from a vein is less good), and it is tied off in two places, without danger of an inch apart, and only by a loop towards the heart. Between these two ligatures the artery is opened with a lancet and one of the curved tubes is tied in so that the curved end is turned towards the heart in order to receive the blood as soon as the loop above is loosened. In order to be tied in the artery more comfortably without slipping out, this tube has small grooves around it. Now that the animal has been prepared in this way, one opens the human vein with the lancet, as in the case of an ordinary bloodletting, and lets as much blood flow out as one wants; then one takes away the bandage that was put on over the opening in the vein because of bloodletting and puts it back on below. When the blood has been removed from the wound, the bent

end of the above-mentioned small tube, which, to facilitate insertion, is shaped like the beak of a pen and very well polished, is placed in the vein and held there; the animal then approaches the man's arm, unites the two tubes, and lets the blood overflow into the man after the loop, which it holds back in the artery, is loosened. The most convenient position for this operation is that the person sits on a low chair and supports his elbow on the table on which the animal is lying. Small tubes are preferable to large ones because they cannot release too much blood at once and overfill the heart. Coagulation of the blood in the tubes is less of a concern because of their shortness; it could also be prevented by warming the room and the pipes. In order to prevent vomiting or other violent evacuations (which Denis experienced during transfusion in the insane, which we shall soon speak of), it is best to prepare the patient with clystiere and the like and for him not to have eaten for 2 to 3 hours before the operation. In patients who are not deficient in blood, it is better to leave a little more blood than to reintroduce it, and to repeat the transfusion more often to give the new blood time to mix with the old and assimilate. In order to estimate the amount of blood drawn out, one can either have the animal weighed before and after the operation, or one must know how much blood an animal of a certain size contains, and then after the operation let the remaining blood run into the bowl, and accept what is missing as over-transfused, or finally, which one is best, because in this way one does not find out the transferred quantity until after the operation when it is too late, what is best is if one knows how much blood is given through the tubes in a given time, one can measure the duration of the overflow by means of a second clock in order to convey a certain quantity. Those Denis used gave 6 ounces of blood in one minute. This latter method is at least sufficient to determine with some degree of accuracy the amount of blood overflowing. In order to prove the painlessness of transfusion, Denis assures us that he often inserted the transfusion tubes into the veins of people who looked to the side during bloodletting without their noticing it.

§. 42

Transfusion in France did not remain unopposed for long; if the doctrine of blood circulation had long been disputed there, and it was only with difficulty that one could be convinced of the truth of it, an operation based on it, as could easily be expected, threatened to give the then existing healing method a completely different form, did not remain uncontested by the Parisian practical physicians, especially since the friends of transfusion were really in some haste to unconditional praise of it in almost all diseases. This controversy was so much more violent because private passions were mixed into the game on both sides, especially on the side of the opponents, who inspired Brodneid and Facultätshafs (87). Unfortunately, partly because of the fact that so much was fought with the worthless theoretical weapons of the baseless hypotheses of a crude humoral system prevailing at the time, this dispute is often very sterile for the investigation of the truth; but nevertheless the influence which it had on the fate of the transfusion in France and almost all of Europe compels me to go into its details.

The first opponent of transfusion who came to the battlefield with a letter against transfusion addressed to his teacher, the professor and doctor of the Moreau Faculty, was a young twenty-year-old Magister Artium named G. Lamy, or rather, as in Gadroys letters (88) is made very likely, Mr. Moreau himself and another older doctor of the Faculty, to whom Lamy only lent his name.

According to Lamy's assurances, the transfusion is far from being a new way to cure diseases, just a new way of torturing the sick, because:

1. The new blood is mixed with so much old blood on the way to and in the heart that it cannot affect the heart.

2. Lamy says that it will probably not occur to anyone to propose transfusions against diseases caused by excess blood, but it can also do nothing against those that result from excessive heat or deterioration of the blood. The former would be increased by the hot arterial blood, but the venous would either coagulate on the way to the heart, or at least become as hot as the rest of the blood and consequently would not help, and neither of the dilatations would cool as well as the substances brought into the blood in the intestinal canal. In the latter, a small portion of good blood will not be able to improve the great mass of what has been corrupted, but rather deteriorate itself.
3. People will object to me, Lamy continues, that transfusion can at least be helpful in cold illnesses (*maladies froides*) and that old people can eke out a life; but that there are cold diseases I very much doubt, or if they do exist they are very rare and deserve no consideration. Finally, the blood of a young animal being incompatible with the temperament of old men would do more harm than good.

In none of the diseases in which Denis recommends it, for the reasons given, can transfusion provide help; but as far as the folly which, according to Denis, can be cured by it, if one were to transfuse all those suffering from it, the number of the surgeons, even if each, like Briareus, had a hundred hands, the blood of all animals would not be enough. As for the healing of the drowsy young man, the righteousness of Mr. Denis does not make me doubt the fact, but this product is not of transfusion, but of the fear of it, which the spirits of the patient wrapped up in the mass of juices by the fever, made free to ascribe. Denis's second attempt proves nothing other than a robust man can endure a transfusion without harm.

Should someone be gullible enough to be persuaded to undergo the transfusion, sad coincidences are imminent for the following reasons:-

1. Since nourishment is basically only continuous procreation, an animal can just as little be nourished by foreign blood, which consists of particles of a completely different form, if it has not previously been altered by digestion, as an animal can be nourished from the seeds of another's blood, but the foreign blood must necessarily spoil in the veins and cause disease. That Denis states that his dogs did not experience any disadvantage from the infused calf's blood proves nothing; perhaps the time in which these disadvantages show up has not yet come, perhaps they really were there, but just weren't noticed.

   Animals have parts that man does not have, e.g. wool, horns, claws, etc., for which the particles from which they are formed must necessarily be in the blood; these must now be brought into a person and either perish, or also produce the parts mentioned. How? and should one, in addition to what one dares in marriage, expose oneself to the danger of becoming a new Actaeon without having been so happy as he was to have seen Diana naked in the bath?
2. Since the mental qualities and inclinations depend on the blood, animal blood would make people stupid and animal, and one would incur the punishment of Nebuchadnezzar by the transfusion without having healed like him. Denis' assurance that animals are less exposed to irregular emotions than humans can not possibly be founded, for how else would one call an unrestrained passionate person brutal.
3. Most animals do not live as long as humans, and consequently their blood is poor and unsuitable for transfusion.
4. The blood of animals becomes fermented at certain times and can thereby be detrimental to man. Finally.
5. It is so difficult to recognize the temperament and constitution of an animal that one cannot easily choose what is useful for the patient (89).

§. 43
Denis' response to this transfusion attack did not last long. Like his opponent, he too made use of a pen, or at least the name of one of his pupils, C. Gadroys, and gave his defence in the form of a letter to the doctor of Queen Christine of Sweden, Abbé Bourdelot.

The first thing that Denis opposes to Lamy is his experience with animals which for five months have been perfectly fine with foreign blood, about which he refers to the testimony of many distinguished persons, namely Mr. von Montmor and Mr. von Bourges. In addition to those already mentioned, Denis made the following new attempt.

With Emmerez's help, on 8th July 1667, he poured the blood of a young goat, in the presence of many distinguished people, into a small twelve year old, very low Spaniel bitch, who was already powerless before old age. In a short time she became stronger and livelier than before, and eight days later was even on heat (90).

§. 44
Denis's reputation as a transfuser and the reputation of transfusion had already become so powerful by this time that even a distinguished patient near death was expected to be rescued by it, and this caused Denis to undertake the following strange transfusion, the striking success of which was due to the several learned physicians who were eyewitnesses of it, were convinced of the effectiveness of this operation, he opposed his opponent Lamy.

On 24th July 1667, Denis relates, four doctors gave up a distinguished stranger, Baron Bond, son of the Prime Minister of the King of Sweden, whom they had been treating for three weeks for Fluxus hepaticus with lienterich bilious diarrhoea and a very violent fever. After all the bloodletting on his arms and feet, and the many evacuations and enemas which the doctors had thought necessary, he became so weak that he could no longer move and lay there without speech or reflection and with persistent vomiting of everything he enjoyed. The doctors now declared: there was now no more help, as one could no longer bleed his veins, nor could he be given anything through the mouth or through enemas. In the meantime, in order to leave no stone unturned, the relatives of the patient made up their minds to seek help from transfusion, and with this desire rushed to Denis and Emmerez. Both immediately went with them to the patient, but, as they saw his desperate condition, absolutely refused to perform the transfusion on him. All of their reasons, however, with which they supported their refusal to the patient's relatives, that this operation could not possibly cure the corruption of the solid parts and the probably already present cold fire, did not help them: they came to them three or more times with new requests, the relatives of the sick man asking that they reassure them that he would not be allowed to die without trying everything possible. Denis and his assistant finally had to give in, but declared beforehand that they would not do anything without a public declaration by the patient's previous doctors that they had given up the patient and consented to the transfusion and that they would undertake the operation only in their presence. The patient's family doctor, who is valued as a skilful and intelligent man in the Paris Faculty, immediately submitted the required testimony for himself and his four colleagues in the presence of several notables, with the added declaration that the transfusion would, according to his opinion, not promote the death of the patient, since he probably only has two hours to live. Denis and Emmerez no longer had any reservations; and on the morning of the day mentioned they actually poured some blood from a calf into the patient's veins.

Although he was already lying there in lethargy with convulsions and a very sunk and rapidly creeping pulse (*poulx fort enfoncé et fourmillant*), it rose at once, as one had already seen about two blood-letting bowls (*palettes*) (each of three ounces, like other places probably suggest), the pulse became stronger and stronger, the cramps

stopped, the patient gazed rigidly at those gathered around him, and gave all sorts of evidence of perfect consciousness by talking sensibly and in different languages with his friends. At last he fell asleep gently and calmly. After three quarters of an hour he woke up again and took several bouillons [broths], tisanes [herbal teas], and geleen [jellies] throughout the rest of the day, without breaking anything [sic] or giving it up through bowel movement, since he had not been able to keep anything to himself for the previous three days and had never been free from lienterie [diarrhoea] during his entire illness. This state lasted for twenty-four hours; but then his strength began to decrease again; his pulse sank again and evacuations of the intestinal canal occurred with extreme fainting. His friends, who the day before had seen such a striking improvement after the transfusion, asked Denis to repeat it. As convinced as Denis was of the incurable corruption of the patient's inner parts, in order to satisfy them, he set up a small transfusion similar to the previous day at six o'clock in the morning. After this the patient regained some strength and took his bouillon well and without vomiting; but the evacuations through the anus did not cease, and towards noon the strength gradually began to subside again, his death, occurred at five o'clock in the evening without the slightest convulsions.

At the opening of the corpse the ileum was found to be pushed into one another from top to bottom, and below it formed a knot, the whole intestinal canal was thoroughly miscoloured, gangrenous, and smelly. The pancreas was extraordinarily hard, and the ducts of it clogged by the indurations. The spleen was four inches thick, the liver very large and miscoloured in several places; the heart very dry and as if burned. In the veins, even in the one in which the transfusion had been carried out, and in the heart ventricles, almost no blood was found, as Denis suspects, because what little that had been poured into him was immediately sucked in by the dry and hot flesh. All these circumstances were confirmed by twelve credible persons who were present at the opening of the corpse, and by the report which the doctors prepared to send to the parents of the deceased (91).

§. 45

As much as Denis attaches importance to these and the preceding facts, and as emphatically as he reproaches Lamy for opposing his attempts with mere theoretical reasons, since even a hundred years earlier it was declared a poison from mere rationales and was severe forbidden antimonium, which the faculty now instructed through experience, had publicly recommended as a splendid means to which the restoration of the king was to be owed; it showed how little evidence possessed by mere reasoning without experience, so he was, according to Lamy's own confession (see the beginning of the letter), too good a Carthesian philosopher to fight with mere facts, and should not have ventured into the field of theory with his opponent, about the gross errors in his reasoning which he accuses him to uncover. The way he does this is simply not the gentlest.

How unfounded Lamy's assurance is that an animal cannot be nourished by the blood of another can be seen, says Gadroys or Denis, from the fact that an animal of another species, e.g. a donkey with a mare can produce a mule that is well fed by the foreign blood of its mother in the uterus. Grafts thrive very well on the sap of a tree of the other species to which they are associated. Just as an apple grafted onto a walnut tree, instead of an apple tree, will not bear nuts, so little is there to be feared that wool or horns should grow from the blood of a lamb in people. If Mr. Lamy had studied medicine for a little longer, he would know that the food and the chyle, in addition to digestion in the intestinal canal, the least significant of all, have a second and third more important digestion in the heart, spleen, and liver, and in the finer vessels of the body. He would show that just as in the case of the tree, the coction of the juices that takes place in the roots and the trunk contributes less to the production of certain fruits than the last filtration of these juices in the small pores of

the graft, also the coctions that are found in the stomach, liver and heart, contribute less to giving food the figure which it must have in order to be transformed into the substance of man, than the diversity of the pores in the bones, flesh, and other parts which they are finally filtered, to which the ancients therefore attributed just as much assimilation power. Even if the foreign blood transfused into the veins does not undergo digestion in the intestinal canal, it is, while it circulates with the rest of the blood, so worked up by the other more important digestive instruments that it can be used for human nutrition.

Against Lamy's objection that the fear of the operation would have cured the young soporous man, Denis replies: the person was not afraid of the transfusion, which had been pretended to be insignificant, even if such a passion could have cured him, the horror of the fall of a ladder, which he suffered a few days earlier, would have healed him (92).

Convinced that I have said enough to tell my readers the point of view from which Denis and his opponent, and with them the greatest number of doctors in Paris, viewed transfusions, and with the manner in which the dispute on this subject was conducted, I fail to explain further Denis's reasons for countering Lamy's objections. Denis, as good as his opponent, drew his reasons from the coarse humoral and fermentation pathology prevailing at the time, in connection with the well-known physiological hypotheses of Carthesius, only with the difference that when one tries to isolate everything from the medicine, whatever could be favourable to transfusion, for example, therefore denies the existence of asthenic diseases (93); so the other, in order to be able to recommend transfusion more in a disease, doubts the existence of true full-bloodedness, and only accepts Plethora commota (94), in which, after bloodletting, the transfusion of the cooler blood of an animal could be of use.

§. 46

Whatever impression Denis's attempts at transfusion and his protective script for this operation might have made on the public, at least it did not have the effect to silence one's opponent; rather, he answered with increasing bitterness. If, he says, Denis reproaches me for not having tried transfusion, it means so much: I should first kill five or six people with transfusion to prove that it is harmful, because as far as experiments on animals are concerned, so one would not have believed me their fatal success, or at least one would have ascribed it to my clumsiness in operating. One of the most skilled surgeons in Paris, however, assured in one of the learned meetings with Abbe Bourdelot that a dog on which he had transfused in the presence of some famous doctors from the Paris Faculty had fainted, and afterwards he was awakened from it with difficulty, and died five or six days later (95). If, moreover, animals have endured transfusion without harm, this is due to the fact that their own blood was strong enough to free themselves from the foreign blood as if from an excrement. But such strange blood is completely incapable of nourishment, and therefore the transfusion of animal blood cannot be used in any disease (96).

The reasons with which he supports this judgment are essentially the same as those in his earlier letter; I therefore spare my readers with it.

§. 47

In view of the general attention which the learned as well as the unlearned public in Paris now paid to the transfusion, it was easy to expect that the Royal Society of Science there would take part in this matter, and assist in its further elucidation by experiments. This was done, of course, but by no means with the zeal and care of the Philosophical Society in London; there are only a few attempts, and even of these few we find only a very brief note in Du Hamel's record of the Royal Society (97). They are somewhat more detailed in a small essay by Perrault on transfusion, which

appeared in 1688 in his Essais de Physique, T. IV (98). The following are the attempts:

On 22nd January 1667, a transfusion was undertaken from the femoral artery of one dog into the femoral vein of another. The tubes for this were not made exactly as the experimenters wanted and it was therefore doubted whether much blood had overflowed.

On the 24th of the same month this attempt was made again; the blood flowed from the artery into the vein so easily that a uniform pulsation was felt in the latter, as in the artery. This abundant overflowing blood was immediately fatal to the dog that received it. The right heart ventricle and the superior vena cava were found filled with clotted blood.

On 23rd February, they transfused again. Since the blood overflowed with less violence and in small quantities, because it immediately coagulated in the tubes and in the first veins, the dog that received it did not die, but when it was untied it seemed much sadder and more depressed than the other, who accidentally lost a lot of arterial blood and on whom the operation of tracheotomy and air injection, after previous strangulation, had been attempted.

On the 27th, in a new transfusion, one noticed the same weakness of the animal which had received the blood, and the same coagulation of the blood in the vein, which one could clearly see here, in that the very dilated vein sagged from pressure with the finger, and remained imprinted in two parts without afterwards rising again as before.

On 3rd March, coagulation of the blood in the vein showed the same disadvantage, and it was seen here too that the dog that had received blood was weak and depressed, whilst the other who had given it did not seemed weakened in the slightest.

The sixth transfusion attempt was made on the 15th of the same month. The transfused dog appeared to be less weakened by it than usual; from which it was concluded that he had received little new blood.

In order to know more precisely the amount of blood transferred, both dogs were placed on the weighing pan on 21st March, before and after the transfusion, and they were weighed precisely. The dog that was supposed to receive the blood was previously allowed to drain off three ounces of his own blood, and on the other hand, new blood was passed over into it, the amount of which the scales indicated as two ounces; this was repeated for the second time, so that in all he lost 6 ounces of his own venous blood, and on the other hand received 5½ ounces of new arterial blood. He died the following day after the operation.

The reciprocal transfusion, in which one dog communicates its own blood to another and at the same time receives its blood again, was suggested, but not carried out.

The transfusion tubes shown by Perrault, which were used for the above experiments, were made of metal and of a very special, uncomfortable shape, which in some way explains the frequent clotting of blood. In an appendix, I will give an illustration of this, as well as of the other transfusion instruments. [Note: This appendix is not included in the books available via the Internet – PL]

As far as the unfavourable failure of these attempts is concerned, I can still not ignore the fact that Perrault, an avowed opponent of transfusion (99) tells them (and only in 1688), that furthermore none of the experimenters and the observers take credit, and that finally, a considerable number of the members of the Society refused to allow the publication of these experiments in 1667, where they were made, because they found something wrong with them which, in their opinion, deprived them of evidentiary value (100).

Perrault's objections, which he presented in the Society, only came to light twenty years later.

§. 48
At the same time that Denis and Lamy were exchanging polemics, a non-doctor, Gaspard de Gurye Sieur de Montpolly, Ecuyer and Lieutenant in the Bourgogne Regiment, gave his judgment on the transfusion in a small leaflet addressed to the Abbé Bourdelot (101). After complimenting M. Bourdelot and himself with great self-satisfaction, which prevails throughout the letter, he finally declares transfusion to be an excellent invention, which, however, requires great caution when practiced. The difference in the blood of different animals must necessarily lead to violent fermentation in the veins before they are united together, which would make a total transfusion fatal for the animal, if it could survive the previous drawing off of its own blood. Partial transfusion, however, when the body is still sufficiently strong, is not only possible, but also useful in many diseases, in that here the foreign blood is assimilated by a mild ebullition. Such an ebullition proves the nosebleed of the lethargic young person who Denis had cured through transfusion; it was also proven by the attempts of one of his friends, a very skilful man, who always noticed that the dogs were urinating blood after an abundant transfusion. Denis' litter-bearer had worked hard after the transfusion to give the strange blood the proper shape it had to have in order to pass through the pores of this body; but the Baron Bond died because he lacked the strength to assimilate the foreign blood.

Another proof of the harmfulness of an excessively abundant transfusion is given by the following experiment, carried out with excellent accuracy by Mr. Gayant (102), who let a dog drain three large dishes (plats) full of blood, and then introduced into it the blood of another previously weighed dog. After the operation, the latter dog was reweighed and found to have given the former over two pounds of blood, with the deduction of a few ounces of urine that he left during the operation and an ounce or two of blood that had been poured into a bowl to make sure of the free flow of blood in the tubes. The receiving dog had received an abundant pound and a half more blood than it had previously drained. The effect of this was a strong swoon that lasted almost half a quarter of an hour, and after five days, death, regardless of the fact that he had been carefully tended and bandaged. Gurye ascribes the cause of this to the pungency or acidity into which the much new fermenting blood passed.

At the end of his letter he promises new remarks and experiments about transfusion, which, as far as I know, has not appeared, and tells how he answered Mr. Bourdelot's objections to transfusion in the learned meeting, about new experiments I encouraged on animals and warned against the hasty use of them on people.

§. 49
Better, as just said, Gayant's transfusion turned out to be an old dog who, two hours after the blood of a puppy was poured into him, perked up and jumped around, ignoring the report of an eyewitness to the London Philosophical Society (103), was almost blind when he was old and could hardly move.

About six months later, Denis undertook a similar attempt at the Duke of Guise, by pouring the blood of four rams into a decrepit 26-year-old horse. As Denis writes to Oldenburg, Secretary of the Philosophical Society (104), the old animal regained much more strength and an unusual lust for pleasure.

§. 50
With moderation and impartiality, Doctor Tardy, who had already appeared before on this matter, spoke again for the practice of transfusions on humans (105).

The friends of transfusion, he says, go too far if they extend it to pleurisy and other heated diseases, where it is more necessary to leave veins and where perhaps the injection of bouillons and refreshing decoctions would be more appropriate. It is

also wrongly asserted that animal blood is preferable to human blood for transfusion. The latter is more homogeneous and better worked out, and just as nurse's milk is better for consumption than donkey's milk, so this will be the case with the blood. Without great difficulty it will be possible to find healthy, full-blooded persons for whom the loss of some blood, which is anyway so quickly replaced, is not detrimental. Venous blood is preferable for nourishing, moistening and soothing, whereas arterial blood is particularly useful in cold illnesses and lost spirits. With the very injustice with which the friends of the transfusion deny the plethora, the opponents doubt the existence of a class of very malignant diseases, which arise from exhaustion of the juices and dryness of the body, and those diseases, including diseases in which there is a lack of blood, and the chylification is hindered, certainly cannot be cured better by anything other than the passage of healthy blood, which has already been worked out. This also applies to cold illnesses, which are certainly no less common than heated ones. The assertion that such strange blood cannot be assimilated is erroneous; the blood takes on all impressions, and is easily changed. With blood of the opposite consistency one can achieve something in many diseases, and indeed indirectly also in diseases of the solid parts, and here, because the foreign blood is basically similar in substance to the other, no fermentation arises, unless otherwise one wishes to call the coction that the new blood suffers in the heart and the rest of the body. In order not to weaken the person who gives the blood too much and to overwhelm the patient too severely, it is better to only do small, but often repeated, transfusions. Without these splendid means, the art of healing would be imperfect; previously without it one could only let blood, now through transfusion you are able to give what is missing.

§. 51

As much as the doctors in Paris might still argue for and against transfusion, this dispute before the court of the public at that time had already been declared in favour of this operation, and it seemed like one of the opponents, Perrault, in his writing confesses against transfusion with annoyance (106), as if here too the public, by virtue of their own aversion to the medical profession and their affection for the non-doctors who mess up the science of medicine, believe that in order to save one’s life in an illness, one only needs to be careful, and not to fall into the hands of doctors, "those bloodsuckers and murderers", and on the other hand only to let empiricists use new and unusual means. This mood of the audience with regard to transfusion caused the following, especially its consequences because of the strange transfusion, which was to some extent critical for the fate of the transfusion.

Antoine Mauroy (107), valet in the house of a noble lady, a man of thirty-four, had fallen into a violent madness eight years ago, probably at the instigation of an unhappy love from which he hoped to make a considerable fortune. The first very violent attack lasted around ten months without a break. At last he came to his senses again, and now he was married to a girl whose relatives imagined that his insanity was only the result of a violent illness, of which no relapse was to be feared. But already in the first year of his heyrath [sic] his madness returned, finally disappeared again, but only to reset itself again after a while. In this way his illness came and passed alternately over the years, but the attacks were never shorter than eight or ten months. In vain did the doctors apply their art to his healing; one of them, a man of great repute, bled him eighteen times, made him use forty baths, and innumerable fomentations and internal medicines, but to no avail; on the contrary, the disease increased afterwards to the point of extreme rage, and the decrease was always gradual, and if one spared him medicines. The last fit of madness befell him in September 1667 in a village twelve miles from Paris. His wife travelled to see him to look after him and found him so angry that she had to have him tied up. Nevertheless, he managed to escape his guards and, one dark night, naked without

being noticed, fled to Paris, while his wife went to the neighbouring area without seeing him, and where he swarmed around in the streets, without anyone daring to keep him in the house, because he tore up everything among those who took him out of pity and tried to light a fire wherever he could. So he walked around the streets for three or four months, almost naked and covered with dirt, almost without sleep, and exposed to hunger and cold. Among those who had pity for the sad condition of this man was especially Mr. von Montmor, who made the decision to put him in the madhouse. But before he set this into practice, it occurred to him as an eyewitness to the good effects of transfusion in Denis's experiments, whether one could not bring this unfortunate back to his senses with his help. He had him arrested and sent to Denis and Emmerez to hear their opinion on this. They assured him that, with due caution, this operation would not endanger the patient's life, but whether it would be able to cure him, their experience would not suffice to assert this; it is, however, to be assumed that poured calf's blood, through its greater mildness and coolness, will diminish the heat and the boiling of the patient's blood and thereby bring him relief. On this insurance, Mr. von Montmor had the patient taken to a private house and gave him to the gentle [litter] carrier, on whom Denis had attempted the transfusion described above eight months ago, who was consequently familiar with this operation and, ideally, could convince the patient, bystanders and the guard of its safety.

On Monday, 19th December, the patient's imagination was skilfully prepared for this operation, and it was finally undertaken at about 6 o'clock in the afternoon, in the presence of several notables and a number of enlightened doctors and surgeons. Emmerez let drained ten ounces of blood from the patient's right arm, and passed about five to six ounces of blood from the right femoral artery of a calf into him. The violent reluctance of the patient and the crush of the many spectators prevented him from telling him more; but the sick man's exclamation, "he was fainting," ended the operation and the wound was bandaged. During the operation, he assured that he had felt great warmth up the length of the arm up to the armpit. Two hours later he ate dinner, and spent the whole night, counting a few moments of slumber, as usual with singing, whistling, and such utterances of his madness. The following morning Denis found him less insane than usual; this made him hope that a second transfusion would bring about a more striking improvement. By persuasion he succeeded in making the patient more willing, and so the next day (Wednesday) this operation was undertaken again, in the presence of Doctors Bourdelot, L'Allier, Dodard, de Bourges, and Valliant. This time, considering that the patient had hardly any blood, judging from his emaciated body and the kicks, insomnia and hunger that had previously been endured for three months, only two to three ounces of blood were allowed to flow out of him beforehand, and brought him through the vein of the left arm at least one pound of blood from a calf, as one inferred from the amount of blood remaining in the calf after the operation. The effects of this stronger transfusion were more striking than those of the previous one; just as the blood flowed into the vein, he felt the same warmth in his arms as before; his pulse rose at once; soon afterwards a profuse sweat broke out over the whole face and at the same time the pulse began to become very uneven, the patient complained very much of pain in the kidney region, that he was feeling sick, and that he was about to suffocate if he was not given air. The tube was immediately pulled out of the vein and bandaged. During the bandaging he broke out a good amount of bacon and fat that he had consumed half an hour before, and felt an urge to urinate and even to pass stool. He was immediately put to bed, where, after an effort to vomit for a good two hours, he fell asleep around ten o'clock and enjoyed a peaceful sleep until eight o'clock the following morning. On awakening he was found to be very calm and sensible; he complained of pain and tiredness in all limbs, and left a large glass full of urine, which was so black as if soot* had been mixed into it. [*The German word used in the book is ‘Rufs’, which has been interpreted as being Ruß - PL] When he heard that the time of the Christmas jubilee was near, he asked for a priest whom he

knew to go to confession and sacrament with him. The latter came and found him so sensible that he declared him perfectly capable of receiving it. He slept for the rest of the day and begged those who bombarded him with questions to leave him alone. Notwithstanding this sleep during the day, he slept well the following night. On Friday morning he left another glass full of urine, almost as black as the previous one, and bleeding profusely from his nose; for which reason the physicians thought it advisable to drain him two or three small bowls of blood. On Saturday he repeated his request to be left for confession and for the sacrament; which the called clergymen had no hesitation in giving to him, since he found him to be perfectly sensible. That day his urine started to lighten and gradually returned to its natural colour. His wife, who had hitherto looked in vain for him in the villages, finally found out about his stay in Paris and came to see him. Although it was usual at the sight of her for him to break out in curses and want to hit her, he received her kindly and told her very calmly and properly everything that had happened to him. And yet it was the full moon just now, when, as his wife assured us, his madness was always at its most violent. All who saw him now considered him completely healed; in the meantime Denis, on closer attention, noticed now and then slight traces of mental confusion, which made him wish to start the transfusion on this patient for the third time. This, however, was suspended from one day to the next, and meanwhile his state of mind improved so that all his acquaintances declared that he was just as good of reason as at the time before he became sensible, and that the doctors declared repeat transfusion should be unnecessary. Denis saw him every day and received the most heartfelt thanks from him for what had been produced. He also visited Mr. von Montmor to express his gratitude (108) and he also had to pay a visit to the Prince of Condé, the first President of Parliament, and the professors from the Ecole de Chirurgie (109) to satisfy the curiosity of these gentlemen. In short, his improvement after the transfusion was so undeniable that, as Denis says, only the most lying addiction to defamation could spread that the patient would have fallen into greater madness after it.

The reasoning of present-day physicians about the coincidences that occurred during and after the transfusion was very different. The vomiting was caused by some of the fat consumed before the operation, others by the overfilling of the vessels and the sudden fermentation of the foreign blood in them. Some also ascribed the great tiredness after the operation to the latter cause; others thought that this came from rheumatism, which he suffered while walking around the streets naked and which he was only now beginning to feel. The black colour of the urine is believed by some, to come from bleeding blood in the kidneys, others from black bile that is now being excreted through the kidneys. Denis himself holds back his judgment in the letter in which he tells us this, and only assures that he has observed bloody urine only in two cases in fifty transfusion attempts on animals, and that this can be prevented with security by proper dissection (110).

§. 52

The sensation which this cure made in Paris soon afterwards gave Denis, without looking for it, an opportunity to try the healing powers of transfusion in a disease of another kind. Namely, on 10th February of this year he was called to a paralytic woman, who had suffered from this evil after a blow. The whole right half of the body from head to foot was absolutely without sensation or movement. The eye on the same side was very cloudy and the patient could only see imperfectly with it; the tongue was so lame that she could hardly speak clearly. Her previous doctor had used all the usual means in her illness; he had veined her five times on the feet and arms, and had a great number of internal remedies and enema; the last thing he used were two doses of emetic wine; all of this, as can easily be expected, in vain. Denis did not dare to promise more than probable relief from the transfusion in such

a serious illness, but the patient found herself willing to do anything. He prepared her body for a transfusion some time beforehand, (111) and then poured twelve ounces of arterial blood from a lamb (in his opinion the finest and warmest, which he could only choose) into her veins two different times. A short time later the patient regained the use of her tongue; the right eye became as clear again as the healthy one; soon movement and feeling became stronger again and her spirit became more cheerful, as before. She was able to stand on the previously completely paralyzed foot without complaint, and could now raise her sick arm above her head.

As a witness of this striking production, Denis invokes many people of appearance and righteousness (112). Martin de la Martiniere says (113) that this patient died some time after the operation, but this seems to be one of those obvious falsehoods which one allowed oneself all too often to miscredit transfusion; for according to the letter of a famous and astute Englishman, (this is what the transactions call him) from Paris on 30th November 1669 (114), Denis presented this person and the healed lethargic young person in a court hearing held on the last Friday of the specified month, (from the one below), to the criminal judge as living evidence of the good effects of transfusion.

§. 53

The joy of the patrons of transfusion at the above-mentioned healing of that madman was soon disturbed, however. Two months after the transfusion he was well, but then he exposed himself to causes of illness, whose effects he could as far as possible escape. Without the doctors' knowledge and will, his wife took him home; slept with him four times, notwithstanding the doctors forbade it, gave him eggs, strong soups and the like to eat, and allowed him to go from one tavern to the other, where he got drunk several times. After such an excess, when he smoked tobacco heavily and, in addition to the wine, had a jug (*chopine*) of brandy to drink (115), he fell into a violent fever, which dragged him down in a few days, whether it was the disease itself that caused this, or, which is not unlikely, a succession powder [sic] given to him by his wife. As much as she externally testified to the joy of her husband's production, she was basically repugnant. Before that, partly out of poverty, partly also out of temperament, she had just not led the most decent way of life, wandered about now and then, and often spent whole nights in the streets; now this freedom fell away; her husband carefully guarded her, often criticized her for her dissolute way of life, often quarrelled with her and, not without reason, even accused her of trying to poison him. These are circumstances that have been testified in court by credible persons. The disagreement between them went so far that his wife beat him even during his last illness. Mauroy reciprocated this encounter with a slap in the face, which angered his wife so loudly that she threatened him with death. In order to initiate this threat, in all likelihood she used the fever which Mauroy had contracted for the reasons given, and brought him arsenic, which she had already tried to bring him before (116). Not enough to undertake this poisoning at a time when the sudden death could be ascribed to the fever, so the woman was cunning enough to use transfusion as an aid to conceal her disgrace. In this illness of her husband, therefore, she urged Denis vehemently that he would like to carry out the transfusion on him for the third time, and she threatened that if Denis refused, to force him to do so with the help of the authorities. The next day she asked Denis to come to her for a consultation that afternoon; he went and found Mr. Emmerez there, along with a calf and everything else that was necessary for the operation. Both Denis and Emmerez told the woman that her husband was not in such a situation that a transfusion was necessary, and they wanted to leave again. But she fell at their feet, crying and screaming, and did not rest until she overcame her resistance. Emmerez actually put the transfusion tube into the patient's vein and opened a vein at the foot to drain some blood beforehand. At the same moment, however, violent

convulsions with tremors in all the limbs seized the patient, and no blood flowed into either of the opened veins. Emmerez immediately took the tube out of the vein again and tied it up, and the transfusion was so little carried out on the patient that even the artery of the calf, intended for it, remained unopened. The next night he died.

The following morning Denis and Emmerez went to the woman with another surgeon, and, because of the suspicion of poisoning which the deceased raised about repeated assassinations of this kind by his wife, wanted her body opened in the presence of seven or eight witnesses. The woman, however, opposed this to the utmost, and just as Denis left, as much as she could with the funeral. Because of her poverty, however, she could not cope with the arrangements for this that day. A famous doctor from the Faculty, with whom Denis met at a third place that evening, where they were begging for funeral expenses, was also of the opinion that Denis had to insist on the opening of the corpse, and surgeons were immediately called in for this purpose. The woman, however, resisted again and made all kinds of excuses and lies, and when threatened that the opening of the corpse would be done against her will on the following day, managed the corpse underground before daybreak (117).

§. 54

No sooner had the death of this unfortunate become known than the opponents of transfusion shouted triumphs and stormed Denis again with polemics (of which subsequently), which he initially decided to keep silent. But when he learned that three of the most zealous opponents among the doctors went incessantly to the widow in order to induce her to prosecute Denis for making promises, as if he had killed her husband by transfusion, just as these gentlemen tried to seduce the neighbours into giving false testimony against Denis; soon afterwards the widow herself came to Denis and told him this in order to extort money from him, and since he refused her this, threatened to accept the sum offered by the doctors mentioned for a trial against him: so Denis could not be silent longer. He now filed a lawsuit with the Criminal Lieutenant against the widow and her instigator. The latter immediately imposed the necessary interrogations. Five witnesses confirmed in court what had just been said, and that the woman had secretly brought her husband certain powders that would probably have promoted his death.

Denis' administrator this time was the Royal Advocat, Mr Dormesson. After hearing the complaint and interrogating the witnesses, the Criminal-Lieutenant of the Chatelet in Paris gave the following sentence on 17th April 1668: “In the present case there is evident evidence provided of the following circumstances:

1. That Anton Mauroy was given two transfusions because of insanity, and tried to do it a third time; that the first two times produced such a good result that the patient was in good health and mind for two months after the same.
2. That since the two first transfusions, his wife had given him eyer and consommes to eat, that the doctors had not allowed, slept with him four times and that she took him to her house without the doctors' knowledge or will.
3. That from that time on Mauroy went from one tavern to another and smoked tobacco; that, when he got sick, his wife gave him strong drinks and brought bouillons in which she mixed certain powders, and that, on Mauroy's complaint that she wanted to poison him and had poured arsenic into his bouillon, she prevented bystanders from having a taste, pretending to be tasting it, but throwing away what she had in her spoon.
4. That Mauroy and his wife have had several arguments since that time, that she had beaten him unconscious of his illness, and how he slapped her after such treatment, threatening him that he should regret it.

5. That, at the request of the woman, wanted to undertake the transfusion on the patient for the third time, after a previous persistent refusal to do this without higher authority, but that almost no blood at all had come from the opened vein of the arm and the foot and that the patient cried when the tube was inserted into the vein, although under all circumstances no foreign blood had entered his veins; that the operation was not completed and that the patient died the night after.
6. That the woman did not want to allow the opening of the corpse and falsely pretended that the corpse was already in the coffin.
7. That some time after the death of this person three doctors went to the widow, in order to induce her by money to complain as if the transfusion had killed her husband, that she herself told this to others and had said to Denis that if he did not give her money to return home, I would accept the offer of those doctors. The fact that a witness also testified that she had had him claim lifelong support from Denis means that she does not want to start the trial; finally, another witness assured me that one of the said doctors had offered him twelve Lonisd'or if he wanted to testify that Mauroy had died during the transfusion.

Since, according to the plaintiff, the matter is important enough to deserve investigation, and there are reasons enough to investigate in court where the woman got the powders mentioned, and why she brought them to her husband, and why then had prevented his body from being opened, and the plaintiff demanded that the woman should in the meantime be placed in custody;

He also demands that a personal citation should be issued against the three physicians who have asked them to prosecute the surgeons;

Then finally ask the same person, because the transfusion had been effective twice, and because it was intended to be undertaken for the third time only at the urgent request of the woman who behaved so badly in the care of her husband and suspected of being poisoned, suspend the execution of the decree of personal citation, which is given against the surgeon (118).

As a result of this it was decreed that the widow Mauroy should appear in person in front of the court in order to give answers to questions on the points mentioned, and further that an investigation should be made of the other circumstances in the complaint of Mr. Denis; from now on, however, no one should be allowed to carry out a transfusion without the approval of a doctor from the Paris Faculty.

After this sentence had been pronounced (119), as Denis says, far more aggravating circumstances against the widow emerged; witnesses were found to whom this woman had secretly confessed that it was arsenic that she had poured into her husband's soup (see above), that her husband had given the rest of it to a cat, and that it died from it (120).

§. 55

About: The further success of this remarkable process is the only original passage I know of, where it is mentioned in a more elaborate manner, in the letter of a famous English scholar (the name is not mentioned) from Paris to the Philosophical Society in London, dated 30th November 1669 (121).

Last Friday, (it is said here), in Paris, before the criminal judge of the highest court, the case of Mr. Denis was tried, who had been charged with the death of the madman on whom the transfusion had been made. His advocate was the son of the First President de la Moignon, who appeared here publicly for the first time and pleaded his case admirably and before a very numerous and distinguished meeting in which were the Duke of Enguienne, Luines, Montemart, and Chaulnois. In his defence he presented to the court two persons on whom Denis had transfused with the greatest success; one was the sleepy young person, the second the paralytic

woman who had been restored by Denis through this operation. The case of the complaining widow will be negotiated on the next day of service, but no matter how much it is supported and driven by some scheming persons, one generally expects a good outcome for the defendant in public.

§. 56
About the ultimate failure of this process however, I do not find the slightest news in any of the transfusion documents I searched, and since all older and more recent transfusion historians contain nothing more in their reports than what I have presented above, I would almost like to conclude that none of the pieces of the file have appeared in print. A French writer might be able to find more precise information about it in the parliamentary archives (if the revolution in France did not otherwise destroy them). Until this happens, I cannot but allow myself to assume that, since we do not find out anything from any of the judgments that have been approved by Denis, either the reputation of the three physicians of the Paris Faculty accused by Denis, or Denis's own reputation, inhibited the course of justice, and the suppression of this litigation, a thing not unusual in the former France. It is also possible that Denis' doctorate in medicine and his transfer to the Paris Medical Faculty, which took place around this time, reconciled him with his opponents and put an end to the dispute. By the end of the transfusion and of the violent quarrel it had caused him, Denis had probably become heartily tired, and found it better to practice the usual healing arts in peace and quiet than Doctor of Medicine and Personal Royal Physician (122) (Médecin ordinair du Roy) than exercising his time as a martyr for transfusion.

§. 57
As an impartial historian, it is up to me to recite the above occurrence, which Denis says, based on the story that his opponents give us. These are the often mentioned Lamy and a certain Martin de la Martiniere.

As far as Lamy is concerned, he immediately after Mauroy's death published a very angry letter against Denis (123) in which the following report Denis occurs, partly in slightly different and partly more precisely defined circumstances. The deceased, by the name of Monsieur de Saint Amant (no one else but Lamy calls him that), had been afflicted with periodic madness for eight years, which was more amusing than melancholy, so it was that he served as a buffoon for those who might bother with him; in his madness, however, he was always angry with his wife, tried to mishandle her, and could not stand her around. He was finally picked up in Paris to have the transfusion done on him, and they knew how to persuade him to undergo the same. He was told, when he was transfused, that the calf was to suck the blood from his veins; however, as he saw the way in which it was brought closer to him, he made quite reasonable objections to the possibility of this matter, which Denis could not raise, who consequently, as Lamy exclaims triumphantly, no matter how wise he thinks himself, could not even answer a fool's objections.

For miserable reasons, the poor person was finally to the point that he had a vein open in his arm, from which about five small bowls of blood were drawn, which weakened him so much that he felt close to fainting, and asked if they would like to stop bleeding and give him some wine, which, however, did not happen until the colour of his face, the clouding of the eyes, and the weakness of his voice could no longer fail to recognize the near fainting. After the wine had brought him back to himself, a curved stiletto was inserted into the bloodletting wound to widen it and make it easier to insert a tube. This operation lasted quite a long time, and caused the patient so much pain that he uttered a terrible scream and many complaints, as if he were suffering the greatest torture, since he could be nothing less than very

sensitive by sleeping on the streets during the cold of the winters without complaining. The surgeons, however, continued with their operation, without taking the poor man's complaints into account, and finally inserted a curved tube into the dilated vein, without tying it, in order to spare the patient the pain of exposing the vein. The blood of the calf was then allowed to flow into it, but little of it reached the heart, despite the fact that it flowed with great violence, with a good part running out again next to the tube not tied into the vein, and the patient's body and the bed made bloody, a sight that caused disgust for the operation and pity for those who endured it.

The blood flowed well for a time; during this, one shouted in the patient's ear: What are you feeling Monsieur de Saint Amant? What do you feel? He answered in a weak voice: he felt great warmth up his arm. Thereupon coagulated blood settled in the tube, and prevented the blood from flowing over into the vein, so that it had to be pulled out of it in order to clean it again. After this had happened, however, it was by no means possible to get the sick man to have it reintroduced into the vein, and he was so weak that he had to be given wine a second time. All the spectators were very badly satisfied with the operation, until the unfortunate man finally recovered from his weakness and almost regained something of his previous strength, and through this and through his promise to have the operation carried out again on him the following day, that dissipated the displeasure in something again.

With regard to the second transfusion, Lamy's narrative, as far as the operation and the accidents immediately after it are concerned, essentially does not differ from Denis, but the more so in the more distant successes. The patient, says Lamy, was now almost a fortnight without an attack of his madness, or at least had only slight traces of it, which were barely recognizable and which the gullible were taken to be a mere effect of his natural merriment. However, Denis' great hopes and his triumph over this happy success were soon disturbed; after the lapse of those days indicated, the sickness again seized the patient, and this in such a way that he turned from a cheerful fool into an angry man. He remained in this sad state for five days; on the sixth he fell into a violent fever with terrible convulsions which lasted until his death, which occurred the following day from the severity of the fever, if otherwise the first story I was told is true. But according to another story, which seems more probable to me, Mr. Denis and Emmerez, during this violent fever, carried out the transfusion on the patient, and with such unfortunate success that the poor fool escaped their hands only by death.

If now, Lamy finally fell asleep, after such a bad success Denis should not succeed in gaining access to transfusion, in which he believed he could find a universal remedy for all diseases, the newly acquired doctorate would probably not help him much, since he hardly understands anything of ordinary medicine, unless otherwise Apollo has communicated it to him by a kind of transfusion. Denis has treated me very insultingly in his writings since the time that I tried to nip in the bud the hopes he had built in transfusion for his reputation and advancement, but I will, for the sake of my own calm and because I think that I have said enough, not to continue the argument.

Martin de la Martiniere gives us the following story in his cited work (124), which he assures us to have come from the mouth of the widow Mauroy: The patient fell into a violent mania after an interval of fourteen days without disease. His wife gave him the powders of a certain Mr. Claquenelle, which in this condition were recommended to be useful (according to la Martiniere, these are the powders that Denis claims to have considered poison). Nevertheless, the sick man got worse, and a fever developed. Denis and Emmerez now decided to do the transfusion again and, through their intrusiveness, finally overcame the reluctance of the patient and his wife. No sooner had they started running blood into his veins than he began to scream: Stop! I'm dying! I'm suffocating! The transfusers continued with the operation and called out to him: My friend, you haven't got enough! and so he died in

their hands. The transfusers tried in vain to wake him up again by frictions and volatile smelling water; he was and remained dead. They now both promise the woman money to go to a monastery if she wants to conceal the death of her husband, and to spread that he has gone out of the country; but she had no desire to do this, and this then caused that process.

§. 58

In our time it can hardly be decided with certainty which of the two parties has violated the truth the least; I suppose the truth is more on Denis's side, and I am far from subscribing to the verdict of the author of the little history of transfusion in the French Encyclopaedia, who thinks that Denis was most untruthful, 1) because he was most interested in doing so; 2) because from that time on, transfusion in France and in the rest of Europe went out of use. The reasons for my opinion are as follows:

1. The unreliable character of Lamy and Martinieres: The former was, according to the parliamentary advocate Louis de Basril, a young reckless magister whom his examiners had almost rejected just a short time ago because of his proven arrogance, and whom they found necessary to remind of his humble birth; the latter was a tooth breaker who sold ointments and the like in a public market booth and on the Pont neuf. Basril is a friend of Denis, but there is reason to assume that, as an advocate, he would have been too well aware of the laws against injuries to portray a doctor with a good reputation as a market judge if what he says about him is not true and would have been proven. Both finally did not use their pens on their own initiative, but hired for others, Lamy for Dr. Moreau, Martiniere for a Dr St. Jacques (125).
2. In his work against Denis, La Martiniere allows himself obvious untruths, for example, the paralytic woman died soon after the transfusion, since Denis presented her publicly a year later (see above).
3. None of them have any evidence or credible witnesses for themselves.
4. Denis is a man of respect and, as far as we know, an impeccable reputation, what his two opponents are not.
5. It is not easy to think that Denis should have been able to locate such a multitude of false witnesses in such a short period of time when he appeared in court without either the court or his opponents discovering any of them as such and would have drawn as a punishment.
6. If Denis had really allowed himself as many and so obvious untruths as his opponents accuse him, this could have happened without loss of his civil honour and his credit as a doctor; there is no trace of this, however; rather, the opposite can be inferred from his elevation to the position of royal personal physician.
7. The general decline of transfusion since Mauroy's death can also be explained by other causes, and I need not first tell my readers that it is finally logic of its own to conclude that a man lied because he was particularly interested in doing so.

§. 59

But no matter how much the law was on Denis's side, the reputation of transfusion in France fell very quickly at this time, and so much so that it also had an impact on its fate abroad. An operation that seemed so bold, against which so many physicians argued for numerous and if not good reasons, but at that time the arguments were for valid reasons, validly could hardly have been preserved in the exaggerated reputation among the public even by the strongest defence, which had brought it that unconditional praise of the doctors who were taken with it, and the favourable experiments on humans and animals, which had previously been put in a brilliant light. In the end the public had to come back from these unfounded expectations,

and just as they saw themselves as mistaken in this, it passed, as it usually does, from one extreme to the other, and also rejected the good results that would have come from a limited and cautious application of transfusion for medicine. Just like the main defenders of this operation, either out of self-interest that was somewhat excusable, which prevented them from continuing an argument in which they ran the risk of losing their good careers as doctors, or because they too came back from their exaggerated hopes, when the battlefields ceded, it would have been easy for the opponents to suppress transfusion completely and to such an extent that soon no doctor would dare to suggest this operation, which in the eyes of the public was at least divisive, to his patients. Even if one of them had wanted to get away with this, he would first have to obtain permission to do so from the Paris Faculty, which for the most part consisted of opponents of transfusion, and run the risk of not doing it at all, or in the case of violent blood loss, where the benefit of transfusion is obvious, to receive it too late to be able to save the patient. In addition, there was the practice of this operation, which was associated with many difficulties and what was striking, and for the sensitive patient frightening, in its external appearance. All this adequately explains to us its decay, without our having to resort to a formal official prohibition as the cause of the total neglect of transfusion. *Such a ban has never been imposed on transfusions in France.* I know that this contradicts the generally accepted opinion; I believe, however, that I am sufficiently justified in this assertion, since all those who speak with certainty and citing their source of such a prohibition only cite as such that sentence from the Chatelet on 17th April 1668 (see above) which, however, does not prohibit the practice of transfusion, but restricts it only to the regular physicians of the Paris Faculty and to those non-physicians who wish to be authorized by it (126). Denis himself also had the intention of transfusing a paralytic woman, a neighbour of the one whom he had freed from a similar disease by this means, and seven to eight physicians from the Paris Faculty, even after the formulation of this sentence, opened a subscription by signing their names in order to obtain permission for him from their college (although this attempt was not made for reasons unknown to me). Denis also recalls that this sentence restricts transfusion all the less, since the faculties of Montpellier, Reimes, and the other academies in France, having the same authority as the University of Paris, would hardly be comfortable with first having to obtain permission for a surgical operation from their colleagues in Paris.

§. 60

At the end of the history of this period of transfusion in France, I pause for a while in a few writings on this subject, the essential content of which has not yet been sufficiently drawn out in the foregoing. These are Eutyphrons, la Martinieres and Perrault's polemics against transfusion, and a pair of small pamphlets for the same, by Parliamentary Advocate Louis de Basril and Dr. Sorb.

Under Eutyphron's name, Peter Petit communicated his judgment on transfusion to the public (127). He absolutely rejects it as contrary to all principles of medicine. The fetus is fed not by the immediate overflow of the mother's blood, but in the fetus itself, by what it has sucked in from the placenta. Digestion in the intestinal canal is indispensable, and wanting to nourish a patient directly with foreign blood means as much as jumping down from the roof window of a house to save yourself the trouble of going down the stairs. Since in almost all diseases there is too great a quantity of blood, letting blood and not transfusion would be the real remedy; the chief cause of diseases and the weakness of old age lies, moreover, in the solid parts and not in the blood, and consequently no help can be expected from the transfusion. One could not even do this in blood flows, for if these came from a large, burst vessel, the new blood would flow out again without any use, but if weakness and disruption of the action of any viscera are to blame, then it is to be feared that the new blood, which is disgusting to the whole system, will cause more harm than good as it goes through

the body. Only with a gross ignorance in medicine, can one recommend transfusion in so very different diseases, smallpox, leprosy, erysipelas, pleurisy, the madness and the like.

I have already said above what Martin de la Martiniere was according to his class, I have not seen his work myself, but I can give my readers a sample of the spirit in which it is written, from what has happened in the history of transfusion from him, he can be judged according to the title (128), to deny the circulation of the blood, so that it can be expected in advance that he cannot believe in the transfusion of blood. In his writing he addresses the ministers of state, the authorities, the priests and ladies, the doctors, in short to all the classes, in order to tell them that transfusion is a barbaric operation that has come from the school of the devil himself and those who performed it to be portrayed as true executioners who should be banished to the cannibals and other man-eating nations. He takes no less trouble to prove that this operation is by no means new. He finds traces of transfusion. 1) In the blood bath of the ancient Egyptian kings. 2) In the Book of Wisdom of Tanaquil, the wife of Tarquinius. 3) In Herophilus' Treatise on Anatomy, where it is very clearly described. 4) In an old Jewish author that Ben Israel Manasseh, rabbi of the Jews in Amsterdam, showed him, in which it is said in clear terms: Naam, a prince from the army of the Syrian king Ben Adrad, to cure leprosy, had the blood drawn off and new blood poured into his veins. 5) In the holy book the priest Apollos. 6) In the investigations of Eubages. 7) In Pliny, Celsus and other ancients who declare themselves against the practice of it. 8) In Ovid's Metamorphoses. 9) In the principles of physics of Maximus. 10) In the treatise on the sacrifices of the emperor Julianus, by Libavius, who speaks of them as an eye-witness. 11) Finally, with Marsilius Ficinus, with Abbot Trithemius, Aquapendente, Harvey and Fra Paolo. These testimonials for the age of the transfusion are of course numerous enough, but it's just a shame that they are not as reliable. From the large number of apparently wrong citations in the above, I would like to draw a less favourable conclusion for the rest of the things with good reason; and Mr. Martin is too little known as a credible man to be believed for what he claims to know about the rabbi and from Queen Tanaquil's book. This is all I can say of his writing; she hardly deserves me to stay longer.

Perrault's treatise against transfusion did not appear until 1680 in the fourth part of his *Essais de Physique*, but he assures us that it was written much earlier (1667) (129). The verses of the Paris Society of the Sciences on Animals described therein, which fall in the year 1667, I have already cited in the appropriate place, and since the theoretical reasons with which he denies the transfusion on 10 octave pages in his work are essentially the same as those I have already brought forward from the mouths of other opponents of transfusion, I will ignore them here. In his confused theoretical reasons and the reasons taken from his cited experiments, he himself goes so far as to deny the evidential value of all successful transfusion attempts by others by judging that in all cases where the transfusion did not cause any harm, the surgeon made noises, and really no foreign blood has overflowed, but the good effect is to be ascribed to the bleeding which one had previously set up to make way for the new blood. The great, widespread use of bloodletting, however, has been proven by two thousand years of experience; the disadvantages of transfusion, on the other hand, have been sufficiently shown by two years of experience. In the experiments on animals he rightly remembers that the fact that the blood-bearing animal dies does not yet prove that it has given all of its blood to the recipient, in that death often occurs much earlier than until the whole mass of blood has accumulated. Incidentally, in his preface, which was written in 1688, he speaks of transfusion as something completely forgotten at the time.

The parliamentary advocate Louis de Basril's small script (130) is basically only an appeal to the judgment seat of experience, the content of which constitutes almost entirely a list of the cases and complaints about the low-level cabals of the opponents

that are favourable to transfusion. From a theoretical point of view nothing can be said from this. It closes with a strong invitation on behalf of the author and other lovers, to Denis, yes, to continue with his important investigations without turning to the envious doctors.

The letter from Dr. Sorbiere from Rome to the Duke of Chaulnes begins with a long-drawn-out explanation of animal economics by means of a comparison of it with a machine in which springs, wheels, fire and water work; then there follows unbearable theoretical rubbish about transfusion, quite in the taste of its age, with which I spare my readers. His sincerity, with which he admits that the transfusion attempts of the English, which the secretary of the Philosophical Society, Oldenburg, had communicated to Mr. von Montmor, had only made his countrymen acquainted with this matter, deserved to be mentioned. As an eyewitness, he assures a successful transfusion of a calf into a dog that lived with Mr. von Montmor, and also saw the healing of an old mangy dog through the blood of some young dogs that Denis had communicated to him (131).

I don't dare to say with any certainty whether this is perhaps the lucky attempt that Denis made with the rejuvenation of an old bitch, and which is only told here under a slightly different form.

Because of their same uncertainty, I am citing two other transfusions which I found in the aforementioned history of transfusion in the French Encyclopaedia. Without saying by whom the attempt was made and where the news of the same can be found, it is said there that one attempt, with unfortunate success, of a transfusion of two starlings into a parrot, and that there is also an old horse, one wanted to make young again, that died from transfusion.

§. 61

Transfusion had so preoccupied the warm heads of doctors in France that the less conspicuous infusion was paid attention to by only a few. The little that I find about it, are a few experiments with it on animals, which were made by the Royal Society of Sciences at Paris, and a few others by the famous Drelincourt.

In 1670 and 1671 the gentlemen of the society injected various fluids into the veins of animals. A dog injected with vitreous spirit in the jugular vein died of it after five minutes. The blood in the jugular and superior vena cava, in the heart and the pulmonary vessels, was found to be coagulated, black, and sour; the blood in the lower vena cava below the diaphragm had retained its fluid. The injections of sulphurous spirits, ammonia and spirits of wine prompted many observations which explained the circulation of the blood, and the remarks which had been made the year before about the coagulation and fluidity of blood from various liquids poured on it were confirmed (132).

Drelincourt, the Royal Physician at Paris and later professor at Leiden, made the curious attempt to inject sebum into a dog through the right femoral vein, after having previously drained a few ounces of blood from the left. The dog seemed to be dead; however, on closer observation one could see movement of the chest and heart for brief moments. Drelincourt now hung up the cadaver by the hind feet. The following day he found the feet below the ligature quite oedematous from a lot of yellowish gelatin which had leaked under the skin. Some lymphatic vessels had cracked; the others were full of yellowish lymph that looked like jelly. The ascending vena cava was filled with coagulated sebum up to the liver, and it had deviated to the right and left and surrounded the kidneys in a large mass. The left femoral and iliac veins were free of sebum. The portal vein was bloodless; the vena cava over the diaphragm was expanded to the point of bursting; just like the descending vena cava and the vena azygos; the right ventricle and the right auricular appendage were also very open. The lungs were quite slack, contracted together, bloodless, and lightly attached to the pericardium. The trunk of the vena cava as far as the interior of the

heart contained nothing but black, coagulated blood, in the coagulated clumps of which were jelly-like masses like a polyp. The left ventricle contained little and coagulated blood, less black in colour. The whole aorta was bloodless (133).

Drelincourt's experiments, which he carried out with the admixture of various acids and alkalis with the blood outside the body, induced him to make various attempts at injecting living animals, which were killed by acids with coagulated blood, and by alkalis with dissolved blood. Solid alkalis injected into it dissolved the blood at the same time and gave it a black colour (134).

Bautzmann mentions one of these experiments carried out on 28th January 1673 in his dissertation *de Peste*, p. 18, as an eyewitness. Drelincourt injected an ounce of ammonia into the right auxiliary vein of a strong dog. At the same moment as one could suspect from the violent movement of the dog that the fluid had entered the heart, he died. After your death he remained limp for a long time.

HISTORY OF TRANSFUSION AND INFUSION IN ENGLAND FROM 1667 TO 1700

§. 62

The most splendid period for transfusion, when enough confidence was placed in it that its practice on humans would not be a cause for concern, came a little later in England than in France, and the English followed in the footsteps of the French in this regard. The anxiety through such attempts to put the life of a person in danger, and the fear in the event of an unfortunate failure, would incur the punishment of the stricter laws on this point in England, as Oldenburg assures (135), kept the English from doing so early on what their neighbours dared to do with such striking success.

The first, as far as I know, in England who followed the idea of attempting transfusion on people more seriously is Edmund King, who, as he himself assures, besides a few scruples of conscience, which he made about the admissibility of such attempts, was only prevented by the lack of opportunity to undertake transfusion on people as early as April 1667. His method and apparatus devised for this purpose (which was actually used afterwards on Arthur Coga) he communicated to his friend Oldenburg in a letter on 21st October 1667 (136).

The reputation of successful transfusions to people in France, at last raised the courage of the English, and some friends of transfusion seriously urged the relatives of Thomas Hawker at Yeovil in the county of Somerset, who had been infested with frenzy [phrenitis] for a whole year, to get them to do a transfusion on this sick person; but although his wife was not averse to it, they did not get through with their desire. Neither did they succeed in this with the relatives of Sir John Stowell, one of the most distinguished men in this region, who had the misfortune of being exhausted by doctors because of a madness that was expressing itself with excessive pride and boldness that he found himself in extreme weakness and faint-heartedness (137).

At a meeting of the Philosophical Society on 17th October 1667, Oldenburg urged the members to continue the transfusion experiments on animals, and asked them to consider the best way and with the least danger on humans. He cited the attempts of the French, who were predecessors in this regard (138).

On 24th October of that year, King's method of starting a transfusion on a human was read out at a Society meeting and entered in the register (139). Sir George Ent, on this occasion, suggested that this operation be attempted on madmen from Bethlehem Hospital, and the Dr. King, Thom. Coxe and Hook with Dr. Allen, to speak to the doctor at this hospital about it. They did this on the 31st of this month without, however being able to overcome the doubts about this attempt. In order to raise this, the Society decided to have Mr. Alen asked to the house of Sir Ent with a few

doctors, from among them, Doctors Balle, Theod. de Veaux, Lower, Clarke, and King to consult on this matter. However, this must have expired in vain, since the attempts at Bedlam that it was supposed to induce did not take place (140).

§. 63

Towards the end of the following month, however, the opportunity so far sought in vain by friends of transfusion was found, without being expected; a certain Arthur Coga (141) approached Doctor Lower, probably on his own initiative, in order to have a transfusion attempt made on him for a guinea. This man, who distinguished himself in the history of transfusion, was a poor, thirty-two-year-old Cambridge graduate baccalaureate in theology, with an exaggerated, cranky imagination, and a slightly too warm head (*his brain was sometimes a little too warm*), who, by the way, loved company, in which he spoke Latin well and fluently (142), and on the whole was of such a sense of humour that Lower calls him "*hominem amabili quadam vesania affectum*" (143). On 21st November 1667, Lower submitted a report on this to the Philosophical Society; the same testified very happily about it, and entrusted himself and Dr. King to perform the transfusion attempt on this person.

Two days later, Lower and King were so completely finished with their preparations for this operation that they actually delivered it to Arthur Coga on the morning of 23rd November at 11 o'clock, in a very numerous and brilliant meeting (in which, among others, the Bishop of Salisbury, Howard and five of the most distinguished doctors in London), in Arundel House, owned by the Society. The method by which it was practiced was that indicated by King, the one mentioned above. A silver, somewhat curved tube was tied into the bare carotid of a lamb and, before it was plugged with a silver stopper, the blood was allowed to flow into a bowl for a minute, so that, after the blood had flowed out during the given time, the amount of transfused blood can be estimated.

Twelve ounces flowed out that minute. Arthur Coga, who saw the red arterial blood in the bowl, was pleased with its beautiful colour, and took some on the tip of a knife and tasted it. Just as the taste of the blood did not seem bad to him, so he sat down very calmly and fearlessly for the operation, after having had a little sparking wine (*a cup or two of sherry*) (144) beforehand. The surgeons then opened a vein in his arm, as in a normal bloodletting, and drained six to seven ounces of blood; then they tried to insert a silver transfusion tube into the vein, but, as the vein could not hold it, had to exchange it for another one a third smaller, which had been kept in reserve for this case. Now, with the stopper pulled out, they combined the tube in the lamb's artery, using a communication tube made of quills, with that in Arthur Coga's vein, and let the blood run free. It paused for a minute before it overflowed into the arm, but then over the next two minutes it overflowed so freely that during it one could feel the pulsation imparted to the vein of the arm by the artery of the lamb clearly above the silver tube. Arthur Coga mentioned nothing of that feeling of warmth along the vein which was noticed in several French experiments; perhaps because the blood in the longer communication tube (which was three quills long) was cooled more. After the two minutes mentioned, the surgeons believed that their patient had received enough blood; therefore they separated the tubes and bandaged him, as after an ordinary bloodletting. When the tubes were pulled apart, the blood flowed freely from them, one more proof, besides the pulsation of the vein that the blood really overflowed during the union. According to King's calculation (145), Coga received about ten to eleven ounces of new blood into his veins; to Oldenburg's (146) only nine to ten; for since twelve ounces flowed out of the tube in the sheep's artery in one minute, it could be assumed that a tube a third smaller, even counting that the blood ran more vigorously at the beginning of the operation than towards the end, at least the specified quantity would have passed over.

Dr. King, who seems to have been the main person in the performance of this operation, performed it, as Oldenburg says, with such ease and skill that Coga never even indicated pain by expressions or words during the operation (147). Even after the operation had been completed, he did not appear to be affected by it; on the contrary, he stood cheerfully and as if nothing unusual had happened to him, and smoked a pipe of tobacco and drank a glass or two of vermouth in the presence of all the spectators (a gathering of over 40 people) (148), and assured those standing by that he was just as well as only one of them. After a while he decided to go home, where he passed the rest of the day. His condition was always good, his pulse was fuller and stronger and the appetite stronger than before; he also had three or four bowel movements, as he used to have before the operation. The following night he slept well; towards morning he sweated for two to three hours. Lord Viscount Brouncker, President of the Philosophical Society, and Oldenburg visited him early in the morning on the following day (on the 25th of the month), and found him still in bed in complete well-being. The owner of the house, who knew nothing about the operation and only believed that he had been bled, assured that Coga had been much calmer and more sensible than before. One of the visitors asked him why he preferred to have the blood of a lamb in his veins. Coga replied in Latin with a comical seriousness: *Quia sanguis agni havet symbolicam quandam facultatem cum sanguine Christi; Christus enim est Ovis Dei*. The wound in his arm was closed two days after the operation, and he willingly agreed to have the transfusion done again. His health remained good, as he himself affirmed in a report of the whole experiment, which he wrote in Latin and composed himself, and which he read to the Philosophical Society on 28th November of this year, and in which he very much emphasizes the good effects of the transfusion. He repeated his request that the transfusion should be carried out on him again. The Society, as it was easy to see, accepted his offer, and decided to repeat this attempt as soon as the doctors in their midst considered it expedient (149).

§. 64

The second transfusion attempt on Arthur Coga was finally made in the presence of a large number of spectators by Dr. King, on 12th December of this year. This time King dared a more abundant transfusion, because he took only eight ounces of blood from the patient, and instead infused the patient's veins with 14 ounces of lamb's blood using the surgical method he had already used. This experiment also went well, and, as he relates in his report submitted to the Society on 19th December, Coga found himself perfectly well, in a somewhat feverish but temporary condition. King believed he had to ascribe these feverish movements not to the operation, but to the too many wines he drank after it. Since the large crowd of spectators made it impossible to weigh the blood-giving animal before and after the operation, as King had intended, in order to determine more precisely from this the overflowing amount of blood; so the society decided to try again as soon as a favourable opportunity should be found. King submitted a report on this second attempt to Arthur Coga on 9th January 1668, but it must have been lost, as it is not found in either the Philosophical Transactions or the *Birch History*.

In the meantime, the good Baccalaureate in Theology continued to be at least physically well; as far as his mental state was concerned the transfusion did not improve it as the doctors had hoped. As Lower relates (150), the Society would have gladly carried out a transfusion on him for the third time, in order to bring him back to his senses where possible; but he himself had thwarted the doctors' wish: “genio suo magis quam saluti consulendo”. Hamel and Dr. Blondel, who saw him in London two years later (1669), found him to be robust and healthy in body, but just as great as he was before the transfusion. Hamel explains that he knew a lot about having endured this operation and used to call himself the Martyr of the Philosophical Society (151).

§. 65
With the intention of continuing the transfusion attempts, the Society requested Dr. Croune, in December 1667, with whom Dr. Terne, doctors at one of the London hospitals, to speak with this intention, in order to induce him to choose one of his patients who would seem useful to him and the doctors of the Society. Croune found, as he reported to the Society on 2nd January 1668, that Dr. Terne was willing to take the first opportunity when he could with a clear conscience have this operation done on one of his patients.

At this very meeting, Dr. Croune and King notified the Society, in Mr. Townly's name, about the communication of a transfusion apparatus, so that experiments could be carried out with it. The Society decided to have the necessary silver tubes made for him. On 9th January they were given to Dr. Croune to send to Mr. Townly. During this session, Dr. Willis proposed a transfusion attempt on mangy (*rotten*) sheep.

On 6th February 1668, Oldenburg read Denis' letter to the Society, in which he recounts the healing of a deeply rooted madness through transfusion; and on the 20th of that month, Clarke reported that he knew a poor mad woman who seemed to be sent to him to undergo a transfusion, but who needed to be taken care of after the attempt for lack of maintenance, she would be a burden to the Society. The Society asked him to speak to some of the leaders of the parish to which this person belonged, and to ask them whether they would be able to maintain these patients after this experiment, which the doctors hoped would cure the madness (152).

Of all these intended attempts, however, none were carried out; the unfavourable turn of events which the matter of transfusion took in France, also had an effect on England, and transfusion as a cure for human illnesses fell into miscredit there too, and in the end it was almost completely forgotten.

§. 66
But even if the English physicians and naturalists no longer continued transfusion experiments with the same zeal as before, when a cure for the most serious diseases was believed to be found in them, so, just as that hope did not seem to be proven, and just as transfusion got the voice of the public against it, they did not let it sink as completely as in most other countries, but continued in this period to keep it not unworthy of attention, especially in physiological terms.

A proof of this is the experiment that Dr. Thruston at Chester in the presence of the Bishop of Chester (153) employed on a pair of dogs. He transferred so much blood into a dog from a sheep that had been weighed before the operation and found to weigh fifteen pounds, that after the operation it weighed two pounds more, consequently seventeen pounds. After this forcible increase in its blood mass, the animal was very ill, fell into great restlessness and anxiety, and died. After death his heart was found full of congealed blood, his stomach black and bloody, and all the veins so excessively full of blood and so dilated that the circulation was necessarily interrupted and the animal had suffocated.

The Philosophical Society also continued to occupy itself with transfusion, as the following proposals made in its meetings (none of which, however, were carried out) prove.

On 14th January 1669 (154), Dr. Croune made the suggestion, which has already been made several times, to feed a dog without food for a while by transfusions that are repeated from day to day and more often.

The physicians present in this meeting were instructed to undertake this attempt and orders were given to the operator of the Society to meet with them for this purpose. At the same time the doctors were asked to discuss the advisability of continuing the transfusion experiments, and as soon as they had determined what

kind of patient this operation could best be attempted on, to ask the directors of the hospitals for permission to make these experiments.

On 18th March, Dr. Croune (155) proposed to lock two dogs in a box next to each other, and to circulate the blood from one to the other, to see whether the food given to one could sustain the life of the unfed other. The execution of this experiment he took over himself. As the Society reminder him of his promise on the 6th May, he said that something had already happened with this intention, and promised, as soon as it is possible, to direct him to the work. This attempt, he thinks, would decide whether the blood nourishes or not; it could also be changed so that only one animal was allowed to breathe freely, in order to see whether, with such a communication of blood, one animal could survive without breathing itself through the respiration of the other.

§. 67

Infusion had never met with approval in England, perhaps with the exception of the time of its first invention, and had caused as much attention as blood transfusion, which it had paved the way for, but which overshadowed it and little seemed to be expected of its therapeutic application in this period in England (156): but, on the other hand, they continued all the longer, and even after transfusion had already fallen into decline, continued to attempt infusion from a physiological point of view. We owe the finest that have come to us to Courten, King, Mullen and Clayton.

William Courten, a distinguished Englishman, made the following numerous attempts during his stay at Montpellier in 1678 and 1679, which were only carried out by Dr. John Sloane of the Philosophical Society thirty-three years after his death (157).

On 30th October 1678, he injected an ounce of lukewarm wine into the jugular vein of a dog of good health. For a quarter of an hour after the injection was done, nothing was noticed about him, except that he appeared to be a little dejected. Then he began to choke and vomit persistently and soon afterwards to empty his rectum of hard excrement as well, whereupon he seemed a little relieved. Soon afterwards, however, restlessness and vomiting returned to such a degree that he vomited twelve times in an hour. His bowel evacuation was somewhat more fluid as before, but associated with frequent tenesmus. After an hour and a half he was as if half dead from exhaustion; but when warm broth was poured into his mouth with a funnel, he came to so far that he could stand again. He was carried into a warm room, where he lay as if dying. When he was brought fresh broth an hour later, he was brought back to himself, but after a few restless movements of the body, he began to vomit again, urinated much, howled pitifully, and died with convulsions.

During the section, carried out the next day, firm, reddish, somewhat translucent polyps of the same nature were found in both heart ventricles, the larger in the right ventricle, from where it extended its branches into the vena cava and the pulmonary artery, and the smaller in the left ventricle, from where branches went into the next vessels. Afterwards he found polyps of the same kind not infrequently in other dogs.

On 27th October he injected a drachm and a half of salmiak [ammonium chloride salt], dissolved in as many ounces of lukewarm water, into the jugular vein of a dog, which, as soon as this reached the heart, died on the spot with general convulsions.

A drachm of Sal tartari [potassium carbonate] dissolved in an ounce of lukewarm water killed another dog just as quickly.

An ounce of lukewarm urine from a sober person caused restlessness in the dog when it was injected into the heart, but no convulsions, and immediately after the operation he ate bread with an appetite, and was continuously well.

Courten boiled, on a gentle fire, two drachms of powdered white Helleborus with a sufficient quantity of water, until 9½ drachms remained, allowed this to digest for a day, and expressed it strongly. Without filtering it beforehand, he injected the cloudy

liquid obtained from this into the jugular vein of a dog. The first drops of it, which came into the heart, caused convulsions, and scarcely had the whole quantity been injected than he died, as if struck by lightning, and with an extreme slackness of all muscles.

On 2nd January 1679, he injected lukewarm vinegar into the jugular vein of a dog, which did not experience any bad consequences.

This was exactly the case with another dog, into which he put two drachms of sugar dissolved in an ounce of water into the veins.

One and a half drachms of Spiritus salis [ammonium carbonate salt], dissolved in one and a half ounces of water, killed another dog to the limit by coagulating the blood, especially that in the right ventricle of the heart.

An ounce of alcohol in which one drachm of camphor was dissolved produced an equally deadly effect.

Fifty grains of opium dissolved in one ounce of water; a cat injected with this in the crural vein was at first only extremely depressed and screamed weakly, interrupted, and pitifully; soon thereafter there were tremors of the limbs and general convulsions, with staring eyes and foam at the mouth. The convulsions increased and turned into tetanus, under which she died a quarter of an hour after the injection.

On 7th February, Courten injected a strong, lively dog one and a half drachms of opium dissolved in one and a half ounces of water, into the femoral vein. He immediately indicated the violent action of this remedy by violent movements of the body, by screaming, palpitations, shortness of breath, and general convulsions. All this, however, subsided after a while, and there ensued an addiction to sleep and an apoplectic state so that one could not even wake him up with blows. After an hour he was a little more sensitive to it, and after two hours you could beat him to walk, but his gait was unsteady and he remained dull all the time, and soon fell asleep again. The next day he lost a lot of stinking excrement like rotten blood. The addiction to sleep lasted for three days, and, during all this time, he did not eat any food. Probably, Courten thinks, he would have got away with his life if he had not been exposed to the very severe winter cold during all these times, and properly would have been refreshed by warm broths (158).

After the injection of one and a half drachms of kitchen salt dissolved in one and a half ounces of water into the jugular vein, a dog became extremely thirsty and drank a lot of water; this did not produce any other noticeable effect.

Courten injected half an ounce of olive oil into the veins of a somewhat small dog. The small size of the vein and the tenacity of the oil meant that it took almost half a quarter of an hour before everything was injected. But no sooner had this happened than the dog began to bark and howl, was dejected, and fell into violent apoplexy, without any convulsions or motion, in which it was not even sensitive to external injuries. The breathing was always violent and rattling, and much viscous, watery, and sometimes blood mixed moisture flowed from the mouth. Sometimes this apoplectic sleep was interrupted by spasmodic movement of the diaphragm and the other respiratory muscles, and by involuntary violent barking, which occurred three or four times an hour, but without the apoplexy subsiding. After three hours he died and the bronchi were found full of thick foam.

Another dog died in the same way after an ounce of olive oil was injected into its jugular vein.

A third dog began to gasp and groan after the injection of an equal quantity; a great amount of bloodied serum flowed from his mouth, but without that barking, and so after an hour he died. The lungs of all these dogs were full of very thick foam.

On 27th February he injected ten drachms of highly rectified wine spirit into the femoral vein of a dog. The animal died from it very quickly, and without any barking, howling or convulsions. Shortly before death, breathing became swift but not difficult, and the dog licked its mouth with its tongue as if it tasted something. The vena cava and the right heart ventricle contained very tightly clotted blood.

Injecting three drachms of rectified alcohol into the crural vein of a smaller dog caused it to be afflicted with apoplexy, lying half-dead. The apoplectic state soon passed again, and the dog wanted to get up, but fell down again as if dizzy. The strength gradually increased again, but the drunkenness continued; his eyes were red and shiny, he ran against everything and even seemed unable to feel any blows. Four hours later he was better and ate the bread given him. The next day his health was even better and he probably stayed until Courten finally withdrew him after a while.

Another dog, in which Courten injected five ounces of strong white wine into the thigh vein, was very intoxicated by it, and to a degree almost as strong as the previous one by the wine spirit. But after a few hours the drunkenness subsided, and the animal became perfectly well again.

An ounce of a saturated tobacco decoction, which was injected into the femoral vein, killed a dog very quickly and with convulsions. The same attempt, repeated several times, always had the same outcome.

Ten drops of distilled salvage oil, rubbed with a drachm of sugar, and dissolved in an ounce of water, did not produce any bad effect on a dog injected in the femoral vein.

A drachm of white vitriol, treated in the same way, killed a dog on the spot.

Fifteen grains of urine salt, dissolved in an ounce of water, produced the most violent convulsions in a dog that was injected with it. When this was decreased somewhat, a new injection of the same size, contrary to expectations, did not however produce any fatal effect, as the dog regained its previous health, albeit with some difficulty.

On 27th April, Courten had two drachms of senna boiled with water, and injected three ounces of this still warm decoction into the veins of a very fat, large and strong dog. During the injection, he didn't seem to suffer from it, just as the first hour after the injection, except that he was a little depressed. Thereupon the respiration became faster, one could hear rumbling in the abdomen, and the muscles of the abdomen, the diaphragm, the stomach, and the intestines were violently moved. At last he broke out a great deal of bile, and appeared to be very weak afterwards. Soon the vomiting began again, four times in an hour and a half. Here he was dull and without lust, so that in three days he ate nothing. On the third day, however, the appetite and the previous cheerfulness returned.

Dr. King's name is not as excellent with regard to infusion as it is with regard to transfusion, because I only know of the following attempt at injection during this period by him, which he had already made several times for himself to prove blood circulation, and finally repeated in public. He injected eighteen ounces of milk into an artery of a dog. After half an hour he opened a vein, and from this came milk floating in blood. Milk, neither changed in colour nor in any of its other properties, comes out with the blood. After seven to eight hours, the dogs usually died of convulsions (159).

Dr. Allen Mullen (others write his name as Moulin), a Dublin doctor, injected a quantity of laab (*rennet*), as is used to make cheese, into the jugular vein of a dog. Two or three minutes after the injection there was heavy and short breathing, almost like a woman circling around, and the dog howled. A few minutes later, however, he was better again. Mullen also noticed that the laab made venous blood as scarlet as arterial blood (160).

Concerning his opinion of the harmfulness of mercury to the lungs, Moulin, in Boyle's house, injected an ounce and a half of live mercury into the jugular vein of a dog. Soon after the injection, the dog would get a dry cough from time to time. The wound was bandaged for him, and he did not seem much affected by it that day. The next day, however, the most violent dyspnoea arose, with an asthmatic, resounding respiration; but there was no trace of salivation or swelling of the glands. On the fourth day he died of increasing shortness of breath. At the autopsy, almost a pint of

bloody serum was found leaked into the chest cavity. The outer surface of the lungs was covered with small vesicles the size of a pea, formed by the integuments of the lungs, containing almost all the globules of mercury and a little pus, of which a greater amount could be expelled with the fingers on stronger pressure. The right heart ventricle and pulmonary arteries contained spheres of mercury that were trapped in clotted blood. This clotted blood was unusual in shape and was somewhat firmly attached to the walls and muscle columns of the heart's ventricle. In the left ventricle of the heart there was only firmly clotted blood, strongly attached to the valvules, and no mercury, so that the mercury did not get any further as into the pulmonary arteries and partly got stuck there, partly to be driven between the skin of the lungs it seems, by the force of the arteries. The bronchi, in all their compartments and subsections, were filled with pus and contained no mercury. The globules of mercury stuck under the bronchi in the pulmonary arteries could be driven by pressing into the mentioned vesicles on the surface of the lungs (161).

In connection with John Clayton, Moulin made some experiments on dogs. In the presence of the Philosophical Society, they injected half a drachm of alum, dissolved in a little water, into the jugular vein of a dog, which died of it in less than a minute without the slightest convulsions. In addition to alum, Clayton saw in other experiments, which he performed alone, that some substances produced similar fatal effects; some made the blood more coagulated and brown than others, and both the colour and the consistency were very different in these experiments. Saltpetre killed as quickly as alum, but it made the blood in the heart very bright red and uniform and evenly coagulated.

One dog that survived the infusion (162) became lame and arthritic (*gauty*); another dog died of consumption sixteen weeks after the injection of mercury, and Clayton noticed mercury in the ulcerated parts of the lungs. He now asks whether the consumption resulting from the internal use of mercury in humans is not due to a similar deposition of mercury globules in the lungs. Clayton calls for further diligent continuation of the infusion attempts, especially of such substances and in such doses, which do not kill the animal on the spot (163). A dog that had escaped from the hands of an unknown experimenter ran to Dr. Christopher Pitt and died with him a short time later. Pitt sectioned him and found some mercury in the abdominal cavity. There was also some mercury in the other cavities; all the glands were swollen and full of fluid; the latter was especially the case with the cerebral ventricles, and a large amount of serum, like hydrocephalus, had leaked around the brain.

HISTORY OF TRANSFUSION AND INFUSION AMONG THE GERMANS FROM 1664 TO 1700

§. 68

First of all, the English and French, as the two nations that occupied themselves most and most systematically with these operations, and who in this respect had the greatest influence on doctors and naturalists in other countries, the Germans joined.

The early traces of an acquaintance with transfusion in Germany (1606, 1615), and the actual practice of infusion by Lord of Wahrendorf or his hunter in Silesia in 1642, had no noticeable consequences for these operations.

The knowledge of them had become so little widespread, it was soon lost again; new circumstances first had to induce the reinvention of infusion and that of transfusion, which were soon linked to the former, in Germany. At about the same time two physicians, Major and Elsholz, made a claim on this reinvention, one of whom was guided by his hypotheses of the condition of the dying, the other by

anatomical experiments on the circulation of the blood. Since Major came up with his invention as early as 1664, but Elsholz a year later, I will deal with Major first (164).

§. 69

Johann Daniel Major, Professor of Medicine in Kiel in Holstein, first presented his claims publicly in 1664, in the *Prodromus inventae a se Chirurgiae infusoriae*, when he was still a practicing physician in Hamburg. As early as 1662 he tells here, that he had often thought about where the sick with malignant, especially exanthematic diseases, even after overcoming one or the other crisis, died so often with fainting and anxiety in the precordia. The cause seemed to him to be the tenacity and coagulation of the blood from the malignant miasms, and the only help, to be the excitation of a new sweat, but the use of the best medicinal products to bring about this is in vain, because the patients either could not swallow them, or because the condition of the first route made them ineffective. Finally it occurred to him whether, as in the case of the anatomical injections, some balsamic opening substance could not be driven into the arteries through the mouth with a silver tube, or injected into them with a bladder firmly attached to it.

Several reasons prevented him from publishing this idea, until he finally received news of the English infusion attempts through his friend Sachs von Lewenheimb in 1664. In pain that others had preceded him, he now sat down to vindicate at least some part in the honour of this invention, and wrote the Prodromus mentioned above.

After a long account of how he came to the discovery of infusion, and after having demonstrated its usefulness for resuscitating many agonisers, he finally leads, p. 20, to the rules to be observed when performing this operation, namely: 1) In order to be prepared for the worst outcome, the doctor takes a precaution with an official permit; 2) He must have previously used the most tried and tested means in vain; 3) Let the patient's arm be rubbed beforehand with warm cloths or wine, or puffed with camphor alcohol; 4) Then you open the vein, like with a bloodletting, with a lancet, not with the sniper, but keep your finger on the opening so that either no blood at all or only ¼ or ½ ounce (as the quantity you injected again), flows out; 5) Do not squeeze out the bladder suddenly, just gradually drive the liquor into the veins; 6) By stroking along the vein, encourage the progress of it; 7) On the opposite part place a few cupping heads to revitalize; 8) Where possible the patient need not be accustomed to bloodletting, but especially must; 9) His pulse should not be too dull and intermittent. With the observance of these precautionary rules, the infusion can be used in the smallpox, measles and other exanthematic malignant fevers and in that kind of plague where the blood is not dissolved but rather coagulated; in order to use ammonia spirit (of which half a drachm with 1 drachm *Spir. vini camphoratus*, diluted with 2½ drams of water, is injected in diluted form) and such means brings about a new fermentation in the blood. Greater donations, such as those mentioned, should be avoided in order not to corrode the skin of the vein. He rejects the injection of opiates because of their narcotic nature. The remainder of his work is filled by a few, mostly worthless objections, even made against the above, answered with disgusting expansiveness and erudition.

The next writing in which he deals with infusion (1667) is his *Delicia hyberna*. After almost a whole arc of pedantic, affected modesty of his share in the invention, he assures that he too, as well as the other friends of infusion in France, England, and Germany, saw that this operation could be useful against all diseases whose cause lies in the blood; only he had not dared to recommend this operation against other coincidences than against the thickening of the blood in the dying, in order not to give inquisitive surgeons an opportunity to misuse it. In Lues venerea, epilepsy, some fevers, scurvy, kidney stone disease, melancholy, apoplexy, impotence, sterility, podagra, hysteria and other diseases, infusion can therefore provide help,

just as in phthisis and the fire and the like, because here the medicaments, without being spoiled in the first place, reached the suffering part directly. How seriously the honest but weak Major takes his recommendation of infusion can be inferred from the fact that it was based on mere rumour: his teacher and friend, the doctor and professor in Leipzig, Johann Michaelis had suffered severe paralysis, immediately set out in October 1666 and travelled to Leipzig to help the patient with his art. Fortunately, probably for both of them, Major found his teacher ready to have the operation performed on him, but in such a state of recovery that he himself no longer considered it necessary (165).

In a paper published a little later: *Occasus et regressus Chirurgiae infusoriae*, Major, however, limits the use of this operation somewhat more. The matter, he admits here, is far from being settled, especially as regards the nature of the liquor to be injected. Distilled water, especially prepared in copper helmets, could easily be damaged by its stypticity, especially if one also adds mineral acid spirits; and aromatic and spirit substances could easily put the spirits of life into too violent a movement; oily things would not combine with the blood and would stagnate in the small vessels, and resinous essences would easily let their resin drop. The main purpose of this minor pamphlet by Major is, however, to defend against an unnamed person who, in 1667, wrote a sheet under the title: *Ortus et Progressus clysmaticae novae*, without a place of printing, in which Elsholt's services to infusion are praised, as Major thinks, at his own expense. Major's vanity also stands out so much in these few sheets that the anonymous accusation that his Prodromus is a ‘Scriptum mere theoreticum’ tempted him to threaten the printer and author with the authorities if he does not leave him alone in the future.

In the same year in which the above small writings appeared (1667), Major gave his Prodromus, which has already had two editions, under the title: *Chirurgia infusoria, placidis cl. virorum dubiis impugnata*, for the third time, accompanied by a number of letters from the most famous doctors of his acquaintance at the time, whose judgment he had requested in writing. It is the Doctors Sachs v. Lewenheimb, Michaelis, Daniel Horst, Strauss, van Horne, March, Schenck, Thomas Bartholin, Oldenburg and others. Some of these letters contain nothing but tasteless, exaggerated compliments, others nothing but inedible reasoning; and apart from Bartholin's, Horst's, and Garmann's letters (of those in the following), they are as good as empty of content for us. Major picks eighty-six doubts out of them, of which he answers the first twenty (166) with unsuitable erudition and insipid theoretical garbage; the rest he promises to refute. One can get an idea of Major's vastness from the fact that the answer to the second doubt listed below fills over four-and-a-half sheets. In the preface and on p. 203 he depicts his instruments, a tube the length of a finger and the thickness of a raven feather, which is slightly bent at the front, with a bubble attached to it. For a more precise determination of the dose to be injected, however, he maintains (167) that a small syringe is more preferable, with which one cannot, however, drive the liquid into the blood as gently and gradually as with a bladder. Blowing in with the mouth, which he mentions in his Prodromus, he now declares inappropriate. In addition to injecting medicaments, he thinks, vapours may also be channelled into the veins by means of a specially designed distiller (!). In his Memoriale anatom., where he, p. 11, proposes this clean curative method, he repeats roughly what he said in other places to praise the injection of medicinals into diseases, and proposes another surgery, infusoriam conservativam et diaeteticam, in which fresh milk is to be brought into the veins of people who cannot swallow, to nourish, and to avoid cachexia.

Also as the inventor of the injection of blood from one animal to another, Major posits in his Deliciis hybernis, and calls it Transplantationem novam, in contrast to the sympathetic Transplantation of Diseases, in which many at the time believed that his method is as follows: take one two-finger-long cylinder made of silver, which holds about five to six ounces, one end of which extends into a fine, short, curved

tube, the mouth of which is shaped like a cupping head. The fine end of this cylinder is brought into the vein of the patient, from whom three or four ounces of blood have been drained beforehand, and a bandage has been put on the arm below the opening in order to stop further bleeding. Then the vein of a healthy, full-blooded person is opened and the cupping head-shaped mouth of the cylinder is tightly fitted so that the blood flows in without being spoiled by the outside air. If the surgeon believes that the cylinder is full, he immediately inserts a suitable punch and with it, like a syringe, drives the blood into the patient's veins. In order to prevent the blood from coagulating even more, one could, according to Major, throw beforehand a few grains of volatile staghorn salt or ammonia into the cylinder and heat it from outside by glowing coals. Before the operation both persons should be allowed to relax gently.

Far from thinking, however, of transfusion as favourably as of infusion, or even of bringing it into practice, he shows himself in his Memoriale anatomico (1669, 5th April, s. 12) not a little indignant that doctors paid so much attention to transfusion, and warns against its application in the most emphatic manner. Among other reasons, which he takes from the different properties of blood and the like, which I pass by, he also cites that he makes a scruple of conscience to carry out transfusion on people because of the inner pleasure of blood be forbidden by Pythagoras, yes by God himself. In accordance with this, he considers it his duty to warn all sick people who are dear to their lives against transfusion, and at the same time to determine the few cases in which it is applicable, in a paper on this, which will soon be published (which, however, has never appeared).

We must expect neither very precise nor numerous experiments from a theorist of the type Major was. The few he employed are in his memorial anatomy. s. 18, and told the following.

Major was so convinced of the correctness of his theory regarding the harmlessness of infusion that he dared to make his first attempt on a person (168), namely on a serf of Herr Hans von Thyen, whom he had received on 21st March 1668, in the presence of many spectators, with a small syringe (which he preferred to the clystial bladder in order to be able to determine the dose more precisely), "*liquorem quendam nervino balsamicum*" in the veins. The patient did not vomit afterwards, nor did he purge (*nulla mutatio inelegans perspecta est in toto corpore*) and began to feel better the next day. Major does not give any details of the circumstances of this experiment. The patient did not at least die from this attempt, we see this from the fact that Major thinks of him as alive a year later.

In the presence of Count Detlef von Alefeld, Hieronymus von Ranzau, other notables, Doctors Reyher and Pfenning and others, on the morning of 19th February 1669, Major filled his syringe instrument with a solution of one drahm of opium dissolved in an ounce of lukewarm *aqua folium Sambuci* (169) and brought five or six drachms of this into the right femoral vein of a bitch of moderate size, from which he had previously drained some blood. After the operation was completed, he injected some Lac lunae into the wound, put a little cotton on it and bandaged it with a plaster without sewing it together. The bitch was a little restless for about eight minutes after the injection because (as Major says) of the pain of the wound. But just as, Major continues, the opium was brought into the heart, lungs, and brain, she began to quieten down, and there was some rolling of her eyes and frequent waving of her eyelids. Sleep did not take place however, which Major attributes to elderberry water. From noon onwards and throughout the rest of the day the bitch could hardly keep her eyes open, she waved her eyes incessantly and swayed back and forth as if drunk; also one saw some salivation. The animal, which was believed to have slept for a long time, was then tied up in a corner where it remained quiet for half an hour, but without sleeping. After this time it had, although it had purged abundantly during the operation out of fear, it had such an abundant bowel movement, "*ut vix cumulatius posset*". For the first night after the operation and for the entire day that

followed, she slept almost constantly, and when she was woken, she would neither eat nor drink; she just licked the wound. On the morning of the third day it felt great thirst, and in order to quench it, eagerly ate the snow lying around it. On the fourth and the following days it regained its previous cheerfulness and did not even limp, although the wound from which the plaster had been licked was still open.

Major (170) made a dog intoxicated with fairly rectified wine spirit (*spiritu vini utcunque rectificato*) injected into the veins, without dying from it.

Major promises in his Memoriale anatomico in due time that he will try to infuse tobacco smoke, oil, mercury and antimonial agents; a promise not kept. A mantissa on the Chirurgia infusoria, appended to this mentioned work, has the purpose of eagerly defending his claims to its invention, and is especially directed against Clarke, who had offended Major's vanity by some statements in Philosophical Transactions.

Be it the inactivity that lay in his character, or some other cause that induced him to give up the further processing of infusion; from 1669 until his death (171), as far as I know, nothing by him on this subject appeared in print, when I heard on 28th September 1670 at Kiel, from Heinrich Krüger from Lüneburg, under his Presidio defended dissertation de Clysteribus veterum ac novis, in which he deals with infusion before transfusion, and against the injection of purifying agents into the blood, and transfusion of animal blood into a person, and in which he warns he will fight in his own writings. He would defend himself against immodest attacks on his person and invention with the help of the authorities.

§. 70

The contemporary and rival of the wretched Major (whom I stayed with so long, not because he deserved it for himself, but because of the considerable role he played with his infusion among Germans of the time) was Brandenburg personal physician, Joh. Sigismund Elsholz, who according to his own statement, was guided to the invention of infusion by the anatomical injection of water into the veins of a cadaver, which he undertook in 1661 to demonstrate blood circulation, and made this his invention in 1665, which does him more credit than Major, namely, publicly known after a series of previous attempts (172).

His first attempt consisted in driving an ounce of water into the femoral vein of a large dog by means of a small silver syringe without the slightest harmful effect. The dog licked the wound that had been sewn shut for half an hour and then ran off as if nothing had happened to him.

An ounce of the best Spanish wine he injected into a dog does not cause incidences of drunkenness, because Elsholz thinks the amount was too small.

A very strong hunting dog, very reluctant during the operation, became very calm (*mansuetissimus*) after an ounce of liquid opium extract was injected into its femoral vein. After half an hour he began to sleep so soundly with cloudy and half-closed eyes that if you shook him he would not wake up. When he touched his wound on his foot he lifted his head a little, but immediately let it sink again as if drunk with sleep. When you prick the tongue with a needle after two hours he didn't move at all, and when you drove the needle through the tongue, only a little. Three hours after the injection he tried to get up, but was staggering and running around in circles, and soon fell asleep again. He shrank back before the bread and water that was held in front of him, as if he were afraid of water. Just as the hunting cries were shouted to him, he tried to obey and to get up, but fell as if paralytic into spoor again. He spent the rest of the day and the following night asleep before he came to and could stand on his feet. Little by little he became completely healthy again.

One ounce of alcohol vitae aureus s. catharticus (a dose sufficient for a person) from the Churfürstlichen Offizin [‘Electoral Offices’] caused a dog, into which it was

injected a lot of restlessness and malaise for a few hours, and after six hours finally two profuse bowel movements.

After an ounce of emetic wine from Crocus metallorum, which he brought into a dog's veins, the same broke out with sobs, moans and salivation, two hours later a thin matter mixed with mucus, which he licked up himself at first. He was very restless, lay asleep the following night, and was found dead in the morning; as Elsholz thinks, because of the excessive amount of Crocus metallorum, from which he had taken sixteen grains without filtering the wine before the injection.

A dog, to which Elsholz had an ounce of water in which white arsenic was boiled, began to rattle after a quarter of an hour, with a rumble in the abdomen, foam at the mouth and great restlessness. He passed copious amounts of urine and bowel movements, rolled his eyes, and behaved exactly as he would if he had been poisoned with arsenic through the mouth. For the second hour after the injection he howled loudly with his eyes closed, and soon afterwards he died.

Elsholz had the opportunity to make the following experiments on three soldiers.

The first one, who suffered from an old ulcer on his thigh, but which was already beginning to heal, with the help of the regimental surgeon Horch, put one ounce of aqua plantagini into the vein of the thigh closest to the ulcer with a small syringe, without causing any harm. The patient assured him that the operation caused him almost no pain at all.

Elsholz injected a spoonful of distilled water from Carduus benedictus into the second soldier, whose vein had been opened because of a fever, and brought the third soldier, who suffered from scurvy, a portion of Cochlear water in his veins in the event of a bloodletting, without being aware of it, during which Elsholz made him turn his face away; both, it seems, with no significant good or bad effect, since Elsholz does not mention them.

The diseases in which Elsholz considers infusion useful are: the diseases of the heart, such as for example, lypothymia and syncope (in which you have to inject a heart-strengthening tincture of corals, pearls, gold, amber, bezoar and the like), hot fevers (where you have to use cooling tinctures), malignant fevers, where you have orvietan with Theriac water and the like. Finally, Alexipharmaca advises palpitation. Except for those avoidable diseases of the heart, he also advises apoplexy, epilepsy, angina and hysteria, where either nothing can be brought about by mouth or where other medicinal products have been used in vain, as well as lues venerea, podagra and scurvy whom the chief tool for preparing the blood, to treat the heart ailments, with injection; just like consumption, because here what is injected reaches the lungs faster. You can see from this that his theories of the nature of diseases are not much better than Major's.

Elsholz's opinion of transfusion is favourable: one can use animal blood or the blood of plethoric people to strengthen weak and anaemic people and improve hot blood, and if one can believe otherwise in the sympathetic cures, diseases can be transplanted from a person into an animal, and to reconcile disagreed spouses or brothers through a reciprocal transfusion. The practice of transfusion by means of a syringe is easier, but the transfer by means of tubes is preferable, because the blood is not changed so much. The remaining part of the second edition of his work is historical, and contains the attempts at transfusion and infusion which were made in the various countries before 1667, as far as they came to Elsholz's knowledge.

§. 71

Christian Friederich Garmann, Provincial Physician and Physician at Chemnitz, was made aware of infusion by Major, and the first thing he published about this subject was a judgment on Major's Prodromus (173).

Major, he thinks, is expecting too much from infusion; when the forces of nature have completely sunk, it is not easy to do anything, nor is it easy to moderate the

fever and the surge caused by the injection so that they are neither too strong nor too weak, and fever and fermentation in the juices do not always result is a healing critical sweat.

In a second letter, which he wrote to Major in June 1667, he relates that he had made several experiments on dogs with the injection of agents made from sulphur, of acids, narcotic substances, and purifying agents, but the effect of the same agent is not always found equally.

A dog, on which eighteen grains of raw opium given by mouth had no effect, was, as was suspected, very much affected.

In this letter, Garmann suggests whether children born in asphyxia can be brought back to life with a few drops of Malaga wine injected into the umbilical vein. He expects a lot from this. In this way he brought some Rhine wine into the veins of one of the newly born dogs for Velsuch; it became hot from it; a few drops of narcotic liquor, which he injected soon afterwards caused him to shiver and become numb; a purge agent, which was injected into him after half an hour, made him open and seemed to come to himself again.

He injected half an ounce of mercury into the femoral vein of a dog without seeming to suffer from it. Two hours later it had a normal bowel movement, but did not pass any urine that day (174).

Garmann would have liked to try infusions on people; but he could not persuade any of his patients to do so. To prevent vomiting, empty the intestines before infusion. Purge remedies injected into the veins caused vomiting particularly easily; Alterantia would never have it if there were no crudities in the stomach. He judges transfusion to be useful after strong blood flows, but never in consumption, emaciation and the like.

In a letter dated 1669 he promised to publish his collected infusion attempts; as far as I know, however, they did not appear.

§. 72

Johann Daniel Horst, first Physician at Frankfurt, also wrote his Judicium epistolicum on infusion in 1665, at Major's instigation, in which he distinguishes himself in some pieces by a more healthy theory and practice than was usual at that time.

Major, he says, attaches too much importance to the revival of sweat in malignant diseases, since experience teaches that copious sweat often aggravates these diseases. Major and others attached more importance to the blood than is owed, because the blood's own vitality does not contribute to the circulation of the blood, only the heart, and Harvey has himself, with regard to the peculiar movement of the blood which he has perceived in the cut-up heart, believed to be deluded, in that it was only ascribed to the twitching of the heart. In addition to the heart, the lungs also have a lot of influence on the blood circulation and he is not inclined to accept Maurocordatus that the lungs are cooling tools, but for a "*pneumaticum sanguinis circulandi instrumentum, quod sanguinem caiefaciat*" (175). If, consequently, the cause of the movement of the blood does not lie in the blood itself and in the veins, then it can be of no use to inject medicine into patients whose blood, according to Major's opinion, is stagnant, since they are not brought to the seat of vitality or spirits, which in the more perfect animals are less spread throughout the body than in the less noble calibre animals, but rather are united in one centre. One must therefore seek to work on these in asphyxia, not on the blood. Major's opinion of the ineffectiveness and alteration of the medicaments brought into the intestinal canal also seemed to him exaggerated, for the strongest Cordialia did not first need to be digested in order to be effective, but affected the system far more quickly and in an unknown way. Major wrongly condemns the injection of opium as a narcotic agent: opium is rather an excellent perspiration and an aphrodisiac, and gives the spirits of life such intensity and strength that they work against every disease (*spiritus*

congregat et ita roborat ut insurgant in quemcunque morbum). For this reason he used it in malignant petechial fevers and smallpox and other similar diseases. He would therefore use Opiata and Sulphurea especially for infusion in the cases indicated by Major. By Sulphurea, however, he does not mean common sulphur, but "*Sulphur auri tincturam auri ex auri sulphure cum spiritu vini et saccharo paratam, leviter impraegnatam camphora et opii bene praeparatis aimicis sulphuribus*." Like Marsilius Ficinus meyne, the sacrifice of the three wise men from the Orient also contained an excellent medicinal product. But I'm silent about these and similar things, from which even the sensible Horst could not be free from.

§. 73

In no place in Germany were more numerous infusion attempts made on people than in Danzig [Gdansk], probably because the friends of infusion among the doctors there were helped by the protection of the famous mayor Hevelius in their daring but promising enterprise. It is to be regretted that these experiments have not been closely observed and related.

A soldier stubbornly attacked by the epidemic of lust [sic – presumably syphilis], who had already repeatedly but in vain subjected himself to the cure, and now had holes in his legs, swelling and contracture of the right arm, suffered a violent headache, which increased when he touched the head; in the hospital there towards the end of 1665 a certain liquor (176) was injected into the veins. Within a day and night the pain in the head and the swelling and paralysis of the arm completely disappeared; the holes also healed without other means in two to three days.

Möller does not name the doctor who attempted this; no doubt it is Dr. Schmidt, or (as he usually calls himself), Fabritius, the former city physician of Danzig, who relates this and a few other similar attempts, with some deviation, in a letter to Oldenburg as follows (177):

On three suitable subjects in our hospital we made tests with purifying agents, since we did not expect any noticeable striking effect from alterants. The first, to whom we brought about two drachms of a purge agent into the median vein of the right arm with a syringe, was a strong, robust soldier who was dangerously attacked by the epidemic of lust and had very large exostoses in his arms. Immediately after the injection he complained of terrible pain in the elbow, and the valvules of the vein of the arm were so noticeably distended that we were compelled to rub the distension with our fingers towards the armpit. About four hours after the injection, the arzeney began to work without any major discomfort, and continued to work the following day, so that the patient had very copious stools in all five. The exostobes disappeared without any other means, and no trace of his illness remained (178).

The second attempt was made on a maid, a girl of 20 years who had suffered severely from epilepsy from her youth. A purifying agent dissolved in an antepileptic spirit was injected into her veins (according to Elsholz, op. 6, Gran Jalappa dissolved in *Spiritu liliorum convallium*). She purged of it four times on the same day and a few more times on the following day, and (according to Möller, op. cit.) remained free of epilepsy for a few months. As she subsequently exposed herself too much to the cold air and did not observe any diet, she spoiled herself (*she cast herself away*) (179).

Another patient, a woman of thirty-five, who also suffered to a high degree from epilepsy, received the same remedy in her veins and, a few hours after the injection, got mild bowel movements. On the following day the epilepsy came back, but much less so and finally it disappeared entirely.

All three patients suffered violent and frequent vomiting soon after the injection.

Fabritius in the meantime continued to make use of the authority's permission to attempt infusions in the city hospital. According to a letter from Danzig to Oldenburg

dated 18th August 1668 (180), he injected drugs into the veins of two soldiers who had been attacked by the plague of lust; one got well from it, the other died (181).

Encouraged even more by letters from some members of the Philosophical Society, he, in conjunction with Doctor Scheffler, practiced the injection of altering agents on three patients. One who was contracted and paralyzed by arthritis was in pretty good shape the next day and was soon able to go back to his previous work, and go to the country for the harvest; the second, who was severely affected by apoplexy, did not suffer an attack again after the infusion, and in the third, who had vistula braid [*plica neuropathica*], most of the ulcers healed, and both were within the next three weeks after the operation (as to which time this letter was written), able to do their job. The famous Hevelius, the only one who was present besides the doctors, testifies to the truth of this happy success.

In a letter from Dr. Fabritius to Timothy Clarck on 20th October 1668 he recounts his mostly successful attempts at infusion, which he used to heal various diseases, namely the epidemic of lust, podagras, vistula braid, mania, and the like. The Danzig mayor Behm also wrote a letter to Clarck on this subject in the year mentioned. Both letters were read aloud in the Philosophical Society in 1669, and it was decided that they should be included in the Transactions, in order to stimulate enthusiasm of the English countries in working on this subject again (182); however, they are not found in the Transactions.

§. 74

Infusion was now already enough on the agenda in Germany to make the subject of public academic writings. Michael Ettmüller was the first to appear in 1668 with a school-based dissertation, which he distributed pro loco in Leipzig. At the beginning of it he tells of a few attempts by his predecessors and adds the following ones that he employed himself.

With the help of one of his friends, he injected a drachm of *oleum suphuris per campanam* diluted with an ounce of water into the femoral vein of a dog. At first only somewhat difficult respiration ensued, but this gradually turned into the most violent dyspnoea; in addition there were slight convulsions, and a copious outflow of foam from the mouth, and in this condition the animal died as if strangled.

Shortly after death a lot of thin, reddish, serous moisture flowed from the mouth, with a lot of foam flowing up on top. The lungs had mostly a blackish reddish colour from the congealed blood, were, moreover, almost completely bloodless, and at the same time, along with the bronchi and the trachea, were entirely filled with the above-mentioned serous foamed fluid. In the right ventricle of the heart there was a great deal of extremely black, liquid, but unnaturally thick blood and not a few vesicles of viscous foam, which clung to its walls. There was similar black, thick, slightly coagulating blood in the left ventricle of the heart, the subclavian vein and cava. The aorta and its larger branches, the liver, and the rest of the viscera were almost bloodless and empty. Apparently, says Ettmüller, the blood in the lungs, which had been thickened by the acid, blocked the entry of new blood from the right ventricle and caused the phenomena mentioned.

After the *Oleum tartari* injection, a dog became very restless and screamed as if in great pain, was badly distended and died. The blood was found redder and more fluid than usual.

Ettmüller poured half a drachm of *Mercurius sublimatus* over so much water that some remained undissolved and injected over a drachm of this dissolution into the femoral vein of a large dog. As this got into the veins, the dog, who had been calm while the skin had been cut and the vein dissected, began to move violently and, soon afterwards, died suddenly, after a few deep breaths, with pitifulness howling and violent movement of the body. The blood was found to be perfectly fluid and thin, as it is in strangled dogs, without the slightest coagulation.

In the remaining part of his dissertation (which Haller notes, in his *Bibl. Anotom*. I, p. 564, *bonae notae*, but has hardly had the patience to read it completely) he proves from theory the benefits of infusion. From the *fermnento vitali* in the heart (of a presumably volatile alkalinic kind), which transforms the venous blood into arterial blood and this again into the spirits of life; health and disease arise from the nature of the alkaline and acidic salts in the blood, which make it suitable for the elimination of the spirits of life, and finally from the state of Archeus. In addition, in certain diseases there would be a ferment brought into the body from outside (alkaline nature in the petechiae, among other things, such fevers, acidic nature in scurvy, dysentery, and the like). All of the above diseases would best be cured by direct injection into the veins. In apoplexy, where the blood is too much thickened by an acid, one must inject volatile alkali salts, which one can combine with antihysterics one-to-one in hysteria and hypochondria. In syncope with dissolution of the blood, cardiaca must be combined with mild acids, in the case of excessively coagulated blood (e.g. in *Catorrhus suffocativus*), cardiaca must be combined with volatile salts or with spermaceti (!) in the veins. In hereditary diseases, however, in arthritis (where the acidic acuteness of the disease is in the first place), and in nephritis (where it is easier to act on the diseased part through the intestinal canal), infusion is not applicable. In pregnant women it is dangerous and in children it is difficult and unnecessary. Emetic and purifying remedies would be better given through the mandrel; but sweat-inducing substances, especially those made from cinnamon, ambergris, deer horn spirit with camphor (of which you can inject a scruple to a drachm), would be more useful in the veins in desperate cases. Hidden under a lot of theoretical garbage of this kind from the school of Helmont and Sylvius, we finally find the well-founded warning that since the medicaments used in the veins could not be induced without great agitation, one should therefore not choose this healing method without necessity, and one must be very careful in the dose of medicine. The doctor must be careful not to storm nature by violent means without necessity; on the other hand, however, one must avoid using infusion too late, so that one does not fail to achieve its goal of saving the patient and, moreover, give this operation a bad reputation.

§. 75

Later (1682) Ettmüller also wrote a school-based dissertation on transfusion. In this he proves that, because of the specific differences in blood, it cannot be employed without endangering life; it is unable to restore the strength of old people or those weakened by illness; just as little against diseases of the solid parts. Only very rarely, and in desperate cases, can transfusions be used against diseases of the liquid parts, fever, hypochondria, scurvy, palpitations, etc.; wanting to heal with it should not occur to anyone. Certain types of melancholy and mania permitted their use, as did violent blood flows. You only have to pass small portions of blood over at once. Lower's transfusion tubes are too long and coagulate the blood too easily; he likes the tubes used by Denis better, whose transfusion method he saw used himself during his stay in Paris. Presenting the reasons on which Ettmuller builds these judgments, which take six sheets, since they are a testing kind of reasoning, I spare my readers, since they have probably already had enough in the preceding paragraph. This dissertation does not contain any own experiments.

§. 76

I mention Moritz Hofmann, Professor of Medicine of Altorf, less because of his services to transfusion than because of his claims to its invention. As early as 1662, his student Vehr assured in his dissertation *de Methaemochymia* in 1668, in a lecture in Pavia, he was said to have suggested transfusion using a glass tube in the form of

a Greek Z to cure melancholy and to mention it in a dissertation defended at Altorf in 1663. According to Sturm (183) Hofmann suggests it in his *Institutionibus Med.*, Disp. XXI., in some illnesses, especially rage and lethargy. Klein (184) also mentions him as the inventor of transfusion. Hofmann's friend and pupil Mercklin, however, gives us in his *Ortu et occasu Transfusionis* news of its invention, which makes it appear rather worthless. Hofmann wants to transfer only a few drops and not several ounces of blood through a short tube into the veins of a sick person's hand from a vein in the back of a healthy person's hand, and he considers this little blood to be sufficient to improve diseases of the mind and the body "*quasi per insitionem*", and to change the mass of the blood, as if by a new ferment, especially if one were to take blood of the opposite quality.

§. 77

Up to now people in Germany had been content to dispute and write for and against transfusion; in 1668 they really began to practice it. In France and England numerous experiments on animals preceded transfusion into humans; in Germany they immediately dared to employ it on people, be it because, trusting the attempts of foreign countries, they believed that this operation could be applied to people; or that the less experienced experimenters only carried out transfusions on humans because they are better at keeping still and not making the operation more difficult by resisting, as animals do (185).

The first human transfusion was done in 1668 by the regimental surgeon Balthasar Kaufmann from Küstrin, in conjunction with his pupil, Gottfried Matthäus Purmann, at Frankfurt on the Oder, he cured violent leprosy in three months of the son of the businessman Wesslein from Berlin, by repeatedly draining a large portion of blood from the median vein and pouring in new blood from the carotid of a lamb in its place (186).

With less success they tried transfusion on two scorbutic soldiers from the regiment of Herr von Goltz, and on a fisherman who was suffering from an eroding rash. The patients got much worse afterwards, and overcome by forces, that in a year and a day they hardly recovered from their sheep melancholy (as Purmann calls it).

§. 78

Kaufmann's assistant Purmann, initially a Brandenburg field surgeon and subsequently city doctor in Breslau [Wroclaw], earned even more merit a little later on with infusion, which I am adding here so that I do not have to come back to him. Encouraged by his teacher Kaufmann, and by Elsholz, who was present at the time, he had no hesitation in having infusion performed on him because of persistent, severe scabies, which he suffered from in 1670 at Küstrin. Without having drained any blood beforehand, he was injected with a few spoons of Aqua cochleariae with a little Spiritus theriacalis into the median vein. He fainted during the operation (which he attributes to the failure to bleed and the too violent sudden injection), and got a long-lasting apostem on the arm [spelt Arme, i.e. 'poor' in the book]. But the scab disappeared entirely within three days.

The violent effects of the injected remedy did not deter him, as in 1678, before the Anclam fortress in Pomerania, he was sick with a daily fever, which lasted sixteen weeks with violent thirst and diarrhoea, withstood all means and deprived him of all strength, to have an infusion performed again. He had several spoons full of Aqua cardui benedicti injected into his veins, but only gradually and after draining a little blood beforehand. This time there was neither fainting nor ulcer; the fever took a different course and ceased entirely within eight days.

Later (1679 and 1680) in Halberstadt he administered infusion to three of his patients who suffered from deep-seated epilepsy. The first two, a soldier's wife of 38, and a tailor of 22 years of age, who, three weeks in succession, had an ounce of Spiritus Gran. et Rad. Paeoniae mixed with some Mayene flower spirit into their veins, were completely relieved of their disease. With the third patient, a woman, things did not go well with the above remedy at first; for although the illness did not take place for three months, it came back. But after it, Purmann injected an ounce of Aqua hirundinum, in which a little Sal volat. succin. had dissolved, a couple of times in her veins, the disease remained completely absent in her too (187).

His remarks and judgments about infusion and transfusion, which he presents in his cited writings, essentially agree with those of Elsholz and Ettmüller, so I ignore them here. He has the peculiarity of infusion that he also suggests injection into arteries, in order to bring the medicine more directly and rapidly to any part of the suffering disease; but he himself admits that this method is dangerous and difficult, and is only rarely necessary and applicable. Transfusion is best done from one vein into the other, and by means of a tube that is inserted into another filled with warm water, which is the best way to prevent the blood from clotting.

§. 79

According to the number of writings, for and against transfusion and infusion, this period in Germany was productive enough, but less than anything of value came out on this subject. I am summarizing a part of these writings here in one paragraph, because they are so insignificant.

Irenaeus Vehr defended his pro loco Dissertation de Methaemochymia in 1668. It is only 22 pages long, of which the author also sacrificed four pages to investigate the name of the transfusion. Transfusions should only be made on those who suffered from a persistent chronic disease, whose strength had not yet sunk too much and who were not frightened by the sight of the blood. Between humans one may only transfuse from a vein into a vein, though arterial blood is more excellent, but the arteriotomy is associated with too much danger. The author is very much against the transfusion of animal blood into a human being, and he gives a touching story of a girl who got cat nature from drunk [sic] cat blood. In an emergency, however, the blood of a meek lamb could be taken. He advises that the end of the transfusion tube stuck in the vein be coated with something astringent, so that the vein can be more closely connected and no blood can flow out. Glass tubes could easily crack from the warmth of the arterial blood. The Scopus primarius of the transfusion is Dei Gloria, then healing of the sick.

J. Cornel. Hönn, Praes. Joh. Chr. Sturm, Prof. Phys. et Mathem. Dissers. de transf. sang. historia, method, et artificio; Altorfii, 1676, 34 pages. This dissertation is written with order and moderation.

From p. 1-14 a short history of transfusion up to 1670, according to the Journal des Sçavans, from which I can only say that he was a German doctor, Dr. Philippi, as an eyewitness of Denis's successful transfusion into the sleepy servant, names the litter-bearer and the old horse which was rejuvenated as a result: then the surgical methods of Lower, King, Major, and others. Chapter IV: Judgments of various authors on the transfusion. Chapter V: Author's own judgment. It is very useful for physiological experiments. From the experiments made so far it is evident, 1) that the passage of better blood could at least relieve several diseases, if not make them easier; 2) that one animal can live with the blood of another, and 3) that old people could be brought to better strength for a while by new blood, if not rejuvenated. The former, however, should only be attempted in very serious illnesses, in which it has been tried in vain to improve the juices by medicine, but in which the inner parts are not spoiled; the latter still requires many attempts on offenders or animals in order to be certain of it. Transfusion can be used to help prevent severe blood loss. Human

blood is better, but animal blood is not to be discarded entirely. He very much doubts that disunited spouses can be reconciled through a reciprocal transfusion.

Joh. Ludewig Hannemann, a restless, confused mind and friend and defender of alchemy, astrology and chiromancy, who had risen to professor in Kiel through Cabalen, wrote in 1670 to his colleague Major who in a small hand written sheet (under the title: Ars clysmatica enervata) and in his Ruach universali and in the Prodromo lexici medici (188), violently against infusion. It deserves no further citation. What he thinks of transfusion can be inferred from the fact that in his dissertation de Motu cordis in 1706 he declared the theory of the circulation of blood to be absurd.

The Nuremberg doctor, Georg Abraham Mercklin, wrote his Ortum et occasum transfusionis in 1672; but by chance the manuscript burned in the house of one of his friends, and this delayed its publication by eight years. His writing is voluminous enough (about eight sheets), but contains neither his own experiments nor reasoning. The result is that transfusion from one animal into the other is of no concern to the doctor; those from one animal into a man are to be opposed for many reasons; finally, the one from one person to another does not allow fear of perniciosam animarum confusionem and morom abominabilem mutationem, but it still has to be tested more through experience.

Nothing else than the pompous title (see the register of writings) distinguishes Professor Klein zu Würzburg's program on transfusion (189). A change of mind through transfusion is indeed possible: since, according to Aristotle, an old man only needed to have the eye of a young man in order to see like a young man, the blood of a young man would make an old man bold and cheerful. The transfusion of animal blood is useful, but human blood is preferable.

In 1668, infusion and transfusion found an opponent in Friederich Hofman the Elder, who rejected them in his Metho Medendi; on the other hand the famous Rolfinek, found in his Consiliis medicis, L. II. p. 70, recommends infusion in diseases where the stomach cannot digest or where the patient has refused taking drugs, I am citing a precedent here, as well as that Helfrich Jungken, Physicus in Frankfurth, in his Chirurgia manuali (of which I only know the second edition of 1700), has a section on infusion and transfusion, which incidentally is insignificant. He is more satisfied with the former than with the latter, which he rejects.

§. 80

David Zollicoffer, from St. Gallen, tells in his dissertation De dolore, defended under Moritz Hofmann in 1682 that he and a few friends injected a strong, lively dog with a drachm of Spiritus salis ammoniaci into the iliac vein, which died on the spot with blood that had congealed up the entire course of the vena cava. He also noticed this from a few drops of Oleum vitrioli injected into the veins. In the experiments which his President Hofmann made with the arterial blood of a dog outside of the body, the blood of both Spiritu salis ammoniaci and Oleo vitrioli had also congealed and turned black. Oleum tartari per deliquium however, made it very fluid and florid.

§. 81

Johann Jacob Wepfer, the elder, Archiater of Schafhausen, wrote to his friend, Dr. Rudolph Jac. Camerarius, saying he had killed an old sheep and a pregnant cow with air injected into the jugular vein, and thereby induced him to make the following attempts: After Camerarius had seen through experiments on two bitches that violent injection of air into the jugular vein had caused death on the spot, he injected air into a young dog's right jugular vein from which he had previously drained some blood, only lightly and without great force. After the operation the animal lay quietly and almost without movement, powerless, without screaming, with dull, half-open eyes

and limp, as it were paralytic, numb limbs. It stayed like that for at least half a quarter of an hour; at last it came to, got up and walked around cheerfully.

When, some time afterwards, he violently injected air into the jugular vein of the dog on the other side, a frequent pulse followed, and the limbs slackened without convulsions, and the animal howled; finally it often opened its mouth and died quietly under sustained inspiration. Foamy blood oozed from the wound; the heart with its vessels was expanded with air, but especially the right auricle, in which there was absolutely no blood. There was no congealed blood in any of the ventricles of the heart; instead, when they were opened, only liquid blood foamed with air escaped. The heart's vasa coronaria contained more air than blood. In the whole body the veins, like the asteria, were reddish and very visible, and even in their smallest branches contained clear air-bubbles. Camerarius repeated this experiment on another dog with exactly the same results. The conclusion he draws is that too much expansion of the heart can cause fainting.

§. 82

In the writings of the Schafhausen doctor, Joh. Conr. Peyer, the following infusion attempts are found:

From an anatomical point of view, Peyer injected air into the Cysterna chyli of a cat which had aborted and which appeared completely dead, which penetrated the heart and made it vibrate again. This took several hours. He repeated this experiment afterwards on others, even on human cadavers. In order to produce this effect, he says, it would be good if the air was warm, and from time to time one had to puff it with something warm to support the movement of the heart. The movement was different according to the type of death; it lasted longest when strangled. Injecting it into a vein has the same effect (190).

§. 83

His friend, Johannes de Muralto, in Zurich, wrote the following to Peyer (191): “I inject a liquor, or milk, into the vein of a living dog, and let all of its blood run off on the other side; what happens? Instead of blood, milk is carried around the body, and all muscle fibres become white, yes, the dog survives this injection for a few hours without even a drop of milk sweating into the abdominal cavity during this time. So you have to admit that your theory etc. have a lot against it. "

In my opinion, Muralto is speaking here not of his own but of someone else's attempt; but I quote it verbatim, so that everyone may judge for himself.

Dr. Schmidt, a practicing physician in Strasbourg, reported sudden coagulation of the blood and almost death (*cum mortis periculo*) after the injection of sublimate into the jugular vein of a dog (192).

The merited professor of medicine in Basel, Johann Jacob Harder, made the following infusion attempts:

In the morning of 2nd July 1681, he gave a dog a scruple of tobacco through its mouth, after which an arduous salivation with violent howling, withdrawal of hypochondria, rapid breaths, twitching of the eyes, extremely violent vomiting and also a purge, so that the animal lay dull. In the evening a needle moistened with a tobacco was stuck into the muscles of the thigh and abdomen, whereupon the limbs were again stiff, frequent salivation, alternating trembling movements of the abdomen, and finally vomiting followed, but without frequent convulsions. On the afternoon of the following day, harder tobacco was given him into his veins by inserting a cradle [sic] soaked in it into the open arm vein that was tied below. Soon after, he began to howl violently, and the heart was beating very violently with convulsive beats. Then suddenly the most violent convulsions arose and death. The heart was found full of blood, especially the right auricle, which was very dilated with

bright red blood, which was also seen in the right ventricle. The left auricle was in a natural state. The left ventricle was filled with very bright red blood. The bladder was full of urine (193).

On a stork, on guinea pigs, and other animals, he repeated Peyer's above-described awakening of the heart by injection. The cause of this awakening, he says, could be nothing else than the action of the Substantiae nitro aereae on the life force of the heart (194).

On 28th December 1684, Harder injected about one and a half ounces of freshly squeezed hemlock juice into the veins of a Bullenbeisser [German bulldog], which made him howl, got convulsions, and lay dull and half-dead with a respiration that was now slow, now frequent and gasping. Thereupon he gradually came to and swayed back and forth with his head raised high. Half an hour later he injected him with hemlock juice again; the heart began to pound violently again, the dog howled pitifully and had cramps in the abdominal muscles, the throat and neck. When Harder finally injected him half an ounce of hemlock juice for the third time, his breathing became gasping and panting, and he finally died with a lot of bloody foam flowing out of his mouth and so that the heart still beat now and then with long pauses. They opened it and found the abdomen and intestines inflamed; especially at the end of the appendix and the beginning of the large intestine, a spot about three inches long was swollen, and with very visible blood-vessels. There was blood stained serum in both chest cavities. The lungs were flaccid and quite inflamed on their outer surface, especially on the larger lobes. Much of the foam mentioned above flowed out of the windpipe, and this was also in the alveoli. The right ventricle and auricle were very distended with liquid blood. The blood in the left heart was also fluid. The brain was full of such blood in its blood vessels too.

In October 1684, in the presence of Doctors Burgower, Steheli and Tonjola, he injected air violently into the jugular vein of a dog of moderate size, from which he died on the spot after a short howl. The heart was found to be very distended and almost bloodless, with the exception of a little foamy blood.

Ten days later, with the help of Doctors Meyer and Meister zu Schafhausen, he injected a dog into one jugular vein, *Spiritum urinosum salis ammoniaci*, whilst at the same time in the other *Spiritum vitrioli*. As soon as the operation was over, the dog began to howl violently and had severe palpitations. This did not last long, however, and Harder then killed him by injecting air, as after a long time there was no worse effect, and noticed, in addition to the phenomena described in the previous experiment, when the blood vessels opened, a clear effervescence of cruor, which now and then was common in them.

§. 84

The hard-working experimenter Johann Conrad Brunner, Professor at Heidelberg, injected a dog (to which he had cut out the pancreas half a year ago without causing any harm to refute the avoided effervescence of pancreatic juice with bile) in order to kill his anatomy and at the same time to make his death instructive, at ten o'clock in the morning, a dissolution of six grains of Tartarus emeticus in lukewarm water into the crural vein. Not all of the tartar of emulsions got into the veins, as a little of it had precipitated out of the water before the injection. At eleven o'clock he became sad and sick; at noon, when Brunner visited him again, he found erupted bilious matter, and the dog seemed to be fine again. Just as the dog was completely well for three hours, Brunner injected air into the femoral vein with a small tube so violently that you could hear the rumbling of the blown air in the precordia, and the dog immediately began to breathe faster and soon afterwards unevenly and panting began. The vein was then tied and the dog was released, which now lapsed into convulsions and tetanus, and with half-closed eyes and protruding tongue, breathed extremely quickly, as if after a violent run. Soon afterwards he moved his eyes again

and gradually came to, stood up and walked around wearily. After half an hour, Brunner again blew so violently into the femoral vein that the rumble could be heard in the precordia, and that the dog died with evacuation of urine and anus. At the opening the stomach and intestines were found to be very contracted and red, the spleen and lungs very bright red, all parts of the abdomen covered with blood, the veins everywhere distended by air, and so too the heart, especially its right ventricle. There was still some bile in the stomach, and the bladder, which was very red, still contained a great deal of urine, despite the fact that the animal had warned copiously about death (195). Brunner also repeated Peyer's resuscitation of the contraction of the heart in dead animals with success on a dog. The heart moved for four hours until it was completely dry (196).

§. 85

The strangest attempt at transfusion of animals in Germany was made during this period by the Hessian-Cassel Archiater Johann Dolaeus, by transferring the blood from a lively, young and stout dog to another older one, which was so emaciated by mange that it was near death, seemed to be passed on until the former bled to death. The sick dog was doing very well afterwards; the mange went away in a few days, and he became fat and plump.

Notwithstanding this favourable success, Dolaeus nevertheless does not dare to recommend transfusion, which at that time had already got a bad reputation due to what happened to it in France, to recommend for sick people: the blood of animals and even of the single individual among men he says, are too different to be able to be channelled into another despite the disadvantage of one person, and the fibres of the muscles, nerves and membranes would also be discharged from ones own blood in such a way that the newly drawn blood cannot give their proper disposition again (197).

These and other prevailing physiological and pathological theories at the time, in connection with the decline in which transfusion and infusion were advised in France and England, made these operations quickly decline in Germany as well, and now we hardly hear anything further from them. The premature death of their most zealous defenders, Elsholz, Major, and others contributed to this, as Purmann not a little, rightly remembers (198).

REFERENCES

1. S. dessen Diss. de Methaemochymia.
2. S. dessen Tria inventa medica.
3. In seiner Diss. de sanguine.
4. In welcher Bedeutung die Pharmaceutiker und Chemiker das Wort Infusion gebrauchen, ist wohl kaum nöthig zu erinnern, eben so wenig als dass ich, zur Vermeidung von Zweydeutigkeit, es nirgend in diesem Sinne gebrauche.
5. S, dessen Clysm, nova sive ratio qua etc.
6. Olaus Borrichius geht indessen noch weiter; er läfst zwar der Medea die Ehre der Erfindung, indem er diese Operationen nach ihr benennt; schreibt aber den Aegyptiern eine noch frühero Konntniss derselben zu, und meint, sie liabe dieselbe von Aegyptischen Priestern gelernt. (S. 1. c. p. 80). Seine Gründe dafür giebt er nicht an; vielleicht bestand einer davon darin, dass Colchis, wie man glaubt, eine Aegyptische Colonie war.
7. Quae simul ac vidit, stricto Medea recludit
   Ense senis iugulum; veteremque exire cruorem
   Passa, replet succis, quos postquam combibit Aeson
   Aui ore excepros aut vulnere; barba, comaeque
   Canitia posita nigrum rapuere colorem.
   Pulsa fugit macies; abeunt pallorque situsque;
   Adiectoque cavae supplontur sanguine venae;
   Membraque luxuriant. Aeson miratur ei olim
   Ante quater denos hunc se reminiscitur annos.
8. Intrarant iussae cum Colchide limina natae:
   Ambierantque torum: Quid nunc dubitatis inertes?
   Stringite ait gladios: *veteremque haurite cruorem*;
   Ur *repleam vacuas iuvenili sanguine* venas.
   In manibus vestris vita est aetasque parentis.
   Si pietas ulla est, nec spos agitatis inanes,
   Officium praestate patri: *telisque senectam*
   Exigite, et saniem conjecto omittite ferro. L. 7. Metam, vers. 332.
9. Quos liectica senilis exedit, Medici diligentes liquore humani sanguinis, qui arte sublimi destillavit ad ignem, reficere moliuntur. Quid ergo prohibit quominus senio confectos interdum hoc etiam potu reficiamus? Communis quaedam est ac vetus opinio, anicalas quasdam sagas (quae Scriges etiam vulgari nomine nunoupantur) infantium sugere sanguinem, quo pro viribus iuvenescant. Cur non et nostri senes omni videlicet auxilio destituti sangui, nem adolescentis sugant? Sani inquam, adolescentis laeti, temperati, euius sanguis quidem sit optimus, sed forte nimius. Sugant ideo more hirudinum ex brachii sinistri vena vix aperta unciam unam aut duas etc,
10. Z. E. die Verpflanzung von Krankheiten in einen Baum oder ein Thier durch in die Wunde derselben gegossnes Blut, oder jene hunst, die zwey Meneschen in den Stand serzen sollte, in der Ferne auf das Schnelleste mit einander zu correspondiren. Beyde machten sich eine Wunde, liessen sich wechselseitig einige Tropfen Blut hinein fallen, und brachten die Wunde zum Vernarben. Stach man nun die Narbe; so fühlte auch der Andre den Stich, und Wusste nach genommener Abrede über die Zahl der Stictie, den Sinn des Ersteren. S. Staricii Thesaurum Heroum. Part II. und L. III. N. 5. der Steganologia Germanica. Auf diese Weise soll, einer Volkssage in Dännemark nach, die ungläckliche Gaitin des Corfiiz Uhlefeld aus ihrem harten Gefängnisse mit ihrem Manne correspondirt haben.
11. Einige Nachrichten von dem Werke und den Lebensumständen des Verfassers, der sicher kein gemeiner Kopf war, was er auch sonst mag gewesen seyn, und der auch in andern Rücksichten in der Geschichte der Erfindungen nicht unwichtig ift (s. Morhofs Polyhistor p. 21), giebt uns folgende Schrift: Medicinae curiosao specimen, quatuor quaestionum enodatione ostensum, quod sub praesid. J. Ern. Schaperi M. D. et Prof. P. exponet E. H. Fecht. Rostock. 1698. 4. Quaest. IV.
12. Ratio chirurgica insignis et rara, homini communicans extera quae ipsi bona, et interna multa, quao noxia avertens. Quae ratio alias varia agere et alterare in homine possit.
13. S. die Philos. Transact. No.37. Manfredi Rilaz del esperienze fatte in Inghilterra Francia ed Italia, Journal des Sçavans 1667 u. a. m.

14. “Hujusmodi deliniis se delectant Paracelistae: *Erattamen quiqam qui de grege Paricesi esse nol-bat*, et nihilominus magnífica et admiranda proflabat; cujus arres paucis, ut hoc hominum genus amplius innotescat, recensebo. Primo pollicebatur facultatem efficiendi, ut per orbem terrarum agri et terrae quaevis satae frugibus abundarent etc. Rusticum commentum audivimus; cognoscamus et medicum, quod est magai promissi secundum, Proponitur hic regimen venaruni, arteriarum, atque ideo totius hominis. Qua arte? Actione et operatione nova, incognita, insperata, summe salutari Re, Loco, Tempore, immediata, nativa, sola vel ore conjuncta vivendi, nutriendi et medicandi ratione. Quid inde compendii? Spes *renovationis*. Quid praeterea? Modus singularis hucusque plane incognitus, quo plurima et insperata in homine toto ejusque partibus possint efici, ut bona acquirat, malis privetur. Consequens est, ut animus hominum praecipuaeque voluntates et affectus mutentur. Volumus animosum? Fiet! Si sedatum, placidum, excitalum alacrem, benevolum, bonum, et omnino pro arbitratu affectum? Praestabitur: Eadem opera virtus, bonitas, magnanimitas unius, sine suo detrimento transferetur in alterum. Si vis ut affectus iste in alium mutetur, ant redeat ad antiquum, facile et hoc praeftabitur. Tritemius quendam princi. pem una hora fecit literatum, et scientem latine : sed hoc bonum ei ademit vicissim, licet liboraliter donatus. Quid porro? Ellici potest ut animus et vis juvenilis migret in senem, et sana constitution ex sano et optime valente in aegrotum: ut vita seu · per totum hominem nordum tamen mortuum, seu in parte aliqua ipsius, cui imminet sphacelus vel gangraena instauretur, motus restituatur his qui se movere non possunt et roborotur: Insuper totum corpus nutriatur, aut mutetur ad votum etiamsi neque ventriculus neque epar ofhcio suo fungantur, et vel nil vel male agant: ut omnes affectiones et morbi, alias curam respuentes sanentur, postquam expertus fueris, quid cuique conveniat sine antipathia. Ita homo poterit esse animo et corpore sa. nus, poteritque majorem, insuetam insperatamque constitutionem acquirere. Investigavimus quaenam res esset tanti? Invenimus Patrem sectae de rosea cruce non passum esse quemquam in adversam va letudinem incidere, quod prophylactico potente ex tinctura Philosophorum eos praemuniret; Alius characterem antipatheticum commendavit; Paracelsi elixir ex septem planetis, mumiam humidam et siccam hominis laudant alii etc. Ille vero noster, quo quaeso remedio sperabat se ista insperata consequi posse? Assit juvenis robustus, sanus, sanguine spirituoso plenus. Astet exhaustis viribus, tenuis, macilentus, vix animam trahans. Magister *artis habeat tubulos argenteos, inter se congruentes. Apeeriat arterium robusti, et tubulum inserat muniatque; mox et aegroti arteriam findat, et tubulum foemineum infigas. Tam duos tubulos sibi mutuo applicet et ex sano sanguis arterialis calens et spirituosussaliet in aegrotum, unique vitae fontemafferet, omnemque lane quorem pellet*. Sed quomodo ille robustus non languescer? Danda ei sunt bona confortantia et cibi, medico vero *helleborum*.
15. Vult ille noster infoecundas foecundare, eisque policetur media singularia et exoptata, modo inter personas rulla sit antipathia. Quid? num etiam exoletis et emortuis vulvis? Et his quoque sive maribus sive foeminis. Hic enim renovationis adminicula sunt arcessenda, ut licet aetate graves, tamen viribus sint juvenes, possintque procreare, Sane si novus sanguis et spiritus cum animo et calore ex juvenibus foecundis in senilia corpora missus fuerit, aliquid spei esse possit, nisi fallit medicus. Quid inde commodi? Non tantum ut vetulae, renovatae quasi *arte Medeae* per herbas coctas, gignant; sed et pro arbitratu masculus vel foemella concipiatur et generetur; ut homo totus a primo conceptu fiat purior, melior, sanior, minusque obnoxias affectionibus, morbis, peregrinisque cupiditatibus, ad quod media sumenda *sunt ab aliis foecundis* (*hausto sanguine* ex foemina pro foeminis, ex maribus robustis pro viris) ut homo nascatur corpore et animo melior et felicior, etiam ultra media conceptionum, per rationes praestantes, et media exoptata.
16. Frevlich verspricht er Mittel, das vorhandne Geld um das doppelte und dreyfache zu verniehren, und Fürsten und ihre Staaten schuldenfrey und reich zu machen; aber nicht durch Goldmacherey, sondern durch bestimmte Finanzoperationen, vielleicht in Laws Manier.
17. Es sey. mir erlaubt, nur eine von ihnen anzuführen, die mir für die Geschichte der Geburtshülfe Aufmerksamkeit zu verdienen scheint: “Ille noster, sagt Libavius am angef. Orte, *machinam, paedhukcam sive instrumentum fabricare potest, cuius ope partus, ex utero liberetur quando est lubitum*, (pracclara res pro virginibus impraegnatis, no sit opus saltu hippocratico aut phthoricis). Curistud? Quia genethliaci fata pendere ex astrorum momentis et hora nativitatis dicunt. Ut ergo nascatur infans oprima constellatione, illud

instrumentum efficere possit. Difierri vel accele “rari partus eodem valet." Könnte nicht jene machina paedhuica, womit man ein lebendes Kind, um ibm nach Belieben eine glückliche Stunde der Nativität zu geben (ob dies die einzige Absicht war, die unser Ungenannte bey seinem Instrimente hatte, oder ob Libavius sie ihm blos aus Sport unterlegt, lässt sich schwerlich entscheiden) zur Welt schaffen will, eine Art von Geburtszange gewesen seyn?

18. A. a. O. pag. 128.
19. In seinem Methodo parandi tuta et nova medicamenta, Venet. 1628. Cap. 7, p. 170.
20. “Denuo insurget aliquis, frustra haec esse tentanda, dum per pauciora aeque et beno valerans .consequi optata, veluti si quis sanguis e veua exsiliens juvenis admodum salubris, per fistulam in venam seris permeet, insufflante iuvene et sene attrahente et inspirante; ut sanguis iuvenis intus attrahatur a sene, et ne huius egrediatur. Nam hic sanguis potest reparare humidum primigenium, et temperamentum, docente Aristotele: si senex haberet oculam adolescentis, nonne videret ut adolescens? non sentiret et rationaretur ut iuvenis, si cor et cerebrum iuvenis possideret? ergo etiam si sanguinem iuvenis obtineret, viveret ut invenis." - Respondendum, haec minime veritatem attingere, quoniam etc.
21. *Gemelli Careri* Voyage autour du Monde, traduit de l'Italien, T. IV. Paris 1719 p. 299. “Les Bouchers même font voir leur adresse dans les Porcs, qu'ils tuent en leur faisant entrer par les veines des pieds une très grande quantité d'eau, dans toutes les cavités du corps, afin qu'ils posent d'avantage."
22. Diss. de Chir. inf. §. 3.
23. Ephemer, erudit. T. II. part. 1. Eph. 42. p. 491.
24. Memoriale anat. miscellan. §. 5. Er führt den Doctor Reyher als Zeugen an, der, auf seiner Reise in Thüringen, genauere Untersuchungen deswegen beym Basil. Titelius anstellte. Dafs der Herr yon Wahrendorff Urheber dieser von seinem Jäger angestellten Versuche war, beweisen dessen Worte: “Anno 1642. hat Hans Gürge von Wahrendorff, Riremeister in Oberlaussnitz, im Dorf Luhe (oder Luhre) Infusoriam practiciret, indem sein Jäger zum öftern den llunden durch ein Hühnerbeinchen spanischen Wein infundiret, wovon sie gang trunken worden."
25. Oldenburg und Thimotheus Clarke (Philos. Trans. Nr. 35.) bezeugen dies.
26. S. Oldenburgs, Clarkes und Lowers Zeugniss Philos. Trans. N. 7. 35. Oldenburg setzt zwar (I. c. N. 7.) 1659 als das Jahr an, in dem dies vorging, aber irrig, wie aus Clarkes Briefe (N. 35), in dem or dies berichtigt, erhellt.
27. Er bediente sich hiebey eines kleinen ausgebogenen Buches, welches er über die Vene legre, um sie zu fixiren und besser öffnen zu können; eine Vermehrung des gewöhnlichen Infusionsapparats, die er indessen nachher selbst für überflüssig erklärte.
28. Ueberall, woman in dieser Geschichte die Dosis der eingesprützten Flässigkeit und andre wesentliche Umstände, so unbestimmt wie hier, angegeben findet, liegt die Schuld nicht an dem Verfassor, sondern an der Unvollkommenheit der über diese Versuche vorhandenen Nachrichten, in den von ihm angeführten Schriften, die keine bestimmtere Angabe enthalten, welches hier ein für allemal erinnert wird.
29. Boyle on the usefulness of exper. phil. Part. II. Sect. 1. Exerc, II, §. 39. - Philos. Trans, 1665. N. 7.
30. Ob dies mit Einwilligung der Englischen Regietung oder Kraft der Gewalt geschahe, die er als Gesandter über seine Diener hatte, davon sagen die Nachrichten, die davon aufgezeichnet sind, nichts.
31. Boyle spricht zwar a. a. O. von Crocus metallorum; dass man ihm aber nicht dies Mittel in Substanz, sondern nur einen daraus bereiteten Brechwein in die Adern gebracht habe, erhellt aus Clarkes Briefe (Philos. Trans. N. 35). Hieraus und aus der grossen Dosis des Eingesprälzten (2 Unzen) lässt sich mit Grund schliessen, dass der Crocus metallorum, von dem Boyle in den vorhergehenden Versuchen an Hunden spricht, nichts anders als ein daraus bereiteter Aufguss gewesen sey.
32. Boyle a. a. O. §. 40. Phil. Trans. N. 7. 35. Breslauer Samml. 1718. April. p. 990.
33. Philos. Trans. N. 35. steht eine Abbildung derselben. Wegen der Zeit dieses Unternehmens s. Birch History, II. pag. 67.
34. Philos. Trans. N. 35.
35. Birch History, T. I. p. 303. Phil. Tr. N. 7. 1665.
36. Birch, l. c. T. II. p. 41. 48. 50. S. 41. wird es schlechthin Florentiner Gift genannt. Es war so gut bereitet, dass ein Tropfen davon eine junge Katze, der man es durch den Mund

bey brachte, tödtete. Eine Henno, die man mit einer darin getauchten Nadel in die Achselsene stach, erfuhr keine Wirkung davon; wie man die Nadel aber in die Muskeln stach, so verfiel sie in Betäubung.

37. Birch, II. S. 50.
38. Birch, II. S. 54.
39. “Corde interim de pulsu pristino paululum tantuni remittente.” Ob diese Verminderung die Zahl oder die Stärke der Pulsschläge betraf, wird nicht deutlich gesagt.
40. Lower de Corde. p. 70.
41. “Cum variis vini tum cerevisiae injectionibus sanguinem diversorum animalium satis apte et amice congruere.” L. c. p. 196.
42. Lower de corde, p. 191.
43. Birch, II. p. 83.
44. Birch, II. 83.
45. Birch, 1. c. 84.
46. Birch, 1. c. 98.
47. Birch, T. II. 115. Philos. Trans. N. 19 und 20. Decbr, 1766. Lower de corde, p. 196.
48. Eine ausführlichere Beschreibung und Abbildung seines Apparats s. in den Philos. Trans. N. 20. Lower de corde S. 204. Lamzweerde Append. ad Sculteti Armament, chir. S. 54.
49. Phil. Trans. N. 20. Lower de corde 1. c. 196.
50. Birch, II. 115. 117.
51. Philos. Trans. N. 22. 1666
52. Birch, II. 117. 118.
53. S. Dr. Kings Bericht von diesem Vers, an die Societat. Birch, II. 125. Boyles Works V. 363.
54. Birch, II. 123. 125.
55. Birch, II. 124. 132.
56. Birch, II. 133.
57. Birch, II. 133.
58. Birch, II, 133. 134.
59. Birch, II, 161. Philos. Trans, 1667. N, 25,
60. Nicht sechs und dreissig, wie im Birch aus einem Versehen gesagt wird, welches aus dem ganzen Zusammenhange offenbar wird.
61. Birch, II, 162.
62. Birch, II. 164. Philos. Trans. N. 25.
63. Birch, ll. 164. 67. Boyle verlangte in dieser Sitzung, man solle diesen Versuch mehrmals anstellen, um zu sehen, ob dies immer erfolge.
64. Das Kalb entliielt, wie man es hierauf zu Tode bluten liess, noch 67½ Unze Blut.
65. Philos. Trans. N. 25. Birch, II. 166, 167. 179.
66. Birch, II, 166, 167.
67. Birch, II. 179. 189. 190. 191.
68. Ob aus einer Vene oder aus einer Arterie des Lammes, ist nicht deutlich; aus dem Umstande, dass das Blut des Fuchses hellröther davon wurde, möchte man schliessen, dass es aus einer Arterie gowesen sey.
69. Birch, II,190.
70. Beddoes Observ. on the nature and cure of Calculus sea scurvy etc.
71. Scherers Journal der Chemie, ir Bd. 2s St.
72. Haller und die ihm nachschreiben, nennen ihn Jean Baptiste Denis; er selbst unterschreibt sich in seinen Briefen nur Jean Denis.
73. Denis Eifer floss wahrscheinlich aus inniger Ueberzeugung von dem grossen Nutzen der Transfusion, aber auch sein Privatnutzen war damit verbunden, denn sie machte ihn berühmt, und gab wahrscheinlich die Veranlassung, dass er Professor der Medicin, und in der Folge Leibarzt des Königs wurde; f. Lassus Discours historique sur les Decouv. en Anat. Paris 1783. p. 147.
74. Sie blieb indessen doch am Leben, und erholtesich wieder.
75. Journ. des Sçav. 1667. p. 63. Extrait d'une Lettre de Mr. Denis à Mr... du 2 Apr. 1667. Philoso. Trans. N. 25.
76. Denis Lettre à Mr. Montmor touchant une nouv. Manière etc, 1667.
77. Traité de l'écoulement du sang, d'un homme dans les yeines d'un autre. Paris 1667. (April)

78. Denis Lettre eścrite à Mr. Montmor touchant une nouvelle manière de guerir par la Transf. du Sang, Paris, Juni 25.
79. S. die oben angefuhrte Schrift.
80. Denis Lettre à Mr. Montmor etc.
81. Denis macht ihn nicht nahmhaft; aus Lamys bald anzuführenden Briefe scheint zii erhellen, derselbe sey bey Denis Diener gewesen, oder doch nach der Transfusion in Dienst genommen, welches dort angeführt wird, um Denis Glaubwürdigkeit zu verringern.
82. C. Gadroys Lettre à Mr. l'Abbé Bourdelot.
83. Lamy seconde lettre à Mr. Moreau dans laquelle il confirme etc, aus der Erzählung eines Augenzeugen.
84. Diesen Umstand erzählt Denis erst in seinem zweyten Briefe, nachdem ihm sein Gegner Lamy die Versäumung dieser Untersuchung vorgeworfen hatte. Lamy macht deswegen nicht ganz unwahrscheinliche Zweifel gegen die Richtigkeit dessen, was Denis von dieser Veränderung des Blutes erzählt.
85. Denis Lettre à Mr, Montmor.
86. Denis Lettre à Mr. Montmor etc.
87. Acriter in Denisium insurrexerunt nonnulli Medici Parisienses, quia non erat eiusdem ordinis sive non ex Facultate Parisiensi. So sagt Caspar Bartholin, nach der ihm von dem berühmten Duverney mitgetheilten Naclıricht in einem Briefe aus Paris an seinen Vater Thom. Bartholin. S. dessen Acta Hafniens. Vol. III. p. 86.
88. Gadroys Lettre à Mr. Bourdelot, pag. 1,
89. Lettre escrite à Mr. Moreau Dr. en Med, etc. contre les pretendues utilités de la transf. du sang. Paris, 8 Juillet 1667.
90. Lettre escrite à Mr. l'Abbé Bourdolot, par C. G. (Gadroys) pour servir de reponse etc. Louis Basril, Advocat en Parlement, Reflexions sur les disputes etc.
91. Gadroys l. c. Aus den genau angeführten Umständen dieses Falles erhellt, wie selır man Denis der Unvorsichtigkeit und der Anwendung der Transfusion in einer acuten Darmentzündung beschuldigt. Hemman erzählt eine ähnliche Transfusion an einem Prinzen von Condé, wegen eines tödtlichen Morbus coeliacus; er muss aber die von ihm angeführte Stelle der Phil. Transact., wo dies stehen soll, niche gesehen haben, denn dort ist nur von der Transfusion am Baron Bond die Rede.
92. Gadroys Lettre.
93. Lamy Lettre à M. Moreau, p. 5.
94. Gadroys Lettre, p. 5.
95. Wahrscheinlich ist dies Gayants Transfusion, vot welcher im nächstfolgenden Paragraphen.
96. Was er von der Transfusion aus einem Menschen in den andern halte, davon sagt er wesier hier, noclt in dem vorhergehenden Briefe das Geringste.
97. P. 20 und weiter der Leipziger Ausgabe.
98. Zwar wird dort nicht ausdrücklich gesagt, dasssie von der Königlichen Societät angestellt sind, aber die Vergleichung derselben mit denen im Du Hamel lässt keine Zweifel übrig.
99. Auch ohne meine Erinnerung werden die Leser in seinem Schlusso: “der Hund befand sich nach der Transfusion nicht übel; folglich muss er wenig Blut erhalten haben", hiervon einen Beweis bemerkt haben.
100. S, Perrault a, a, O. p. 405.
101. Lettre à Mr. L'Abbé Bourdelot sur la tr. du sang, Paris, 16 Sept. 1667.
102. An einigen Orten wird dieser Name Gayen geschrieben,
103. Philos. Trans, N. 26. 1667, den 3 Juny
104. Philos. Trans. N. 30. Dec. 9. 1667. Basril Reflexions sur les disputes, etc.
105. In seiner Lettre à Mr. Le Breton Dr. Regent pour confirmer les utilités de la Transf, du sang. Paris, 30 Oct.
106. Perrault Essais de Physique, T. IV. p. 405.
107. So nennt ihn Denis und die Sentence du Chatelet; Lamy indessen giebt ihm in seiner Lettre à Mr. Moreau sur la mort du fou etc. den Namen eines Monsieur de Saint Amant.
108. Denis Lettre, s. Philos. Trans. 1668. N. 32. Febr. 10.
109. Réflexions de Louis Basril, Avocat en Parlement, sur les Disputes, etc.
110. Denis l. c.
111. Auf welche Weise; dies bestimmt er nicht näher.
112. Denis Lettre à Mr. Sorbiere, etc. Paris 1688. 2 Mars.

113. S. dessen Opuscule contre les circulateurs et la transf du sang, Paris 1668. und die Encyclopedie, Art. Transfus. aus der ich ihn satire.
114. Philos. Trans. 1669. N. 54.
115. Louis de Basril, a. a. O.
116. S. weiter hin.
117. Denis Brief vom 15 May 1668 in Phil. Trans. N. 36.
118. So wenig auch der übrige Inhalt dieses Decreto es zu erkennen giebt, und so sohr in Denis Briefe es deutlich zu seyn scheint, er selbst sey der Kläger, so muss man doch aus dieser Stelle schliessen, dass Denis Feinde früher schon ein Citationsedict gegen ihn ausgewirkt haben.
119. Extrait de la Sentence rendue au Chatelet etc. in Collections académiques de Dijon, T. II, p. 144-45, und Denis Brief in Philos. Trans. 1668. N. 36.
120. Denis, l. c.
121. Philos, Trans. N. 54. 1669.
122. Als solchen führt ihn Lassus in seinem Discours historique etc. p. 147 auf.
123. Lamy Lettre à Mr. Moreau sur la mort du fou guers par la Transf. Paris, le 16 févr, 1668.
124. Encyclopédie. Art. Transf.
125. S. dessen Réflexions sur les Disputes, etc.
126. Casp. Bartholin sagt zwar 1675 in einem Briefe an Thom. Bartholin (Acta Hafn. Vol. III. p. 86.), die Transfusion an Menschen sey als gefährlich vom Parlemente verbothen, und nur jene an Thieren ere laubt worden: da aber diese Nachricht nur aus einem Gespräche mit Düverney geschöpft ist, in dem über diesen Gegenstand eine andre offenbare Un. richtigkeit vorkommt, und zwar erst sieben Jahre nach geschehener Sache, so kann man ohne Bedenken sich Zweifel gegen die Genauigkeit dieser Angabe erlauben, und mit Grund vermuthen, dass auch er nur von jenem angegebenen Decrete spricht, welches man schon damals als ein förmliches Verboth anzusehen sich gewöhnt hatte. Jene eben er wähnte Unriclitigkeit in diesem Briefe besteht darin, dass gesagt wird, Denis erster Transfusionsversuch an Menschen habe in der jedoch nicht vollkommnen Heilung eines Menschen bestanden, der zwey Jahre lang mit einem Quartanfieber behaftet gewesen war.
127. De nova curandorum morbor, ratione per tr. sang. Paris 1668.
128. Martin de la Martiniere opuscules contre les Circulateurs et la transf. du sang. Paris 1668.
129. Dies bestätigt eine Notiz von derselben in Du Hamel Reg. Soc. Histor. Cap. III, p. 20.
130. Réflexions sur les Disputes, etc. ohne Druckort und Jahrszahl.
131. Mons. de Sorbiere discours touchant diverses exper. de la Transf. du Sang, Rom. 1668. Decbr.
132. Du Hamel, l. c. p. 89
133. Drelincourtii Experim. anatom. Lugd. Bat. 1684. 12. p. 17. Canicidium VI.
134. Mangetti Bibl. Anatom. T. II, p.714.
135. Phil. Trans. N. 28. 1667.
136. Phil. Trans. l. c.
137. Oldenburghs Brief in Boyle's Works, Tom. V. pag. 361.
138. Birch History, ll, p. 201.
139. Phil Trans. No. 28.
140. Birch, l. c. p. 202. 204.
141. King, s. dessen Brief in Boyles Works, T. V. p. 638. schreibt seinen Namen Arthur Cogie und nennt iba Doctor der Theologie.
142. Oldenburgh and King in Boyles Works, T. V. p. 371. 638.
143. Birch, p. 209. C. 4.
144. Oldenburg, l. c. King l. c. erwähnt dieses vor der Operation getrunkenen Weines nicht.
145. Boyles Works, l. c.
146. Philos. Trans, l. c.
147. Birch, l. c. p. 216.
148. Oldenburg, l. c. nach King Canarienwein.
149. Birch, l. c, Phil. Trans. N. 30.
150. Lower de corde, C. IV. p. 209. Birch, II. p. 227.
151. Du Hamel Reg. Soc. Histor. C. III. p. 20.
152. Birch, I, c.
153. s, dessen kurzen Bericht an die Phil. Societat in Birch, p. 316.

154. Birch, 339.
155. Birch, 356.
156. Dies wurde besonders bey der Vorlesung eines Briefes des berühmten Hevelius aus Danzig, in welchem er die dortigen glücklichen Curen init der Infusion erzählt, in der Session der Philos. Societat sichtbar, wo die Gegner so weit in ihrem Unglauben giogen, dass einer von ihnen diese Curen öffentlich für erdichtet zu erklären wagte. Birch, I. c. p. 223.
157. Philos. Trans. N. 335. 1712.
158. Die mindre Empfindlichkeit der Hunde, in Vergleich mit den Katzen, gegen das Opium, zeigt sich auch, wenn es durch den Mund eingegeber wird. Nach Borrichius (Bartlıolin epist. med. Cent. IV. p. 466.) erfuhr ein Hund von einer Gabe Opium, die einen Menschen getödtet hätte, keinen Nachtheil; eine Katze aber, der man eine gleiche Quanó tität gab, wurde davon wüthend. Ein andrer Hund, dem man zwey Drachmen Opium eingab, wurdo davon nur schläfrig, nachdem er sich aber erbrochen, und stinkende Leibesöffnung gehabt hatte, wurde er wieder besser.
159. Birch, II. p. 205.
160. S. dessen Brief an die Soc. vom 4 März 1684 in Birch, IV. p. 295.
161. Phil. Trans. 1691. N. 192.
162. Phil. Trans. 1694. N. 210.
163. Wovon, wird nicht gesagt.
164. Elsholz datirt seine Entdeckung zwar schon von 1661; aber seine Einsprützungsversuche von diesem Jahre bestanden nur in der anatomischen Einsprützung von Wasser in die Venen eines Cadavers.
    Früher wie einer von ihnen, hatte der Pfalzgraf Ruprecht sich mit der Infusion beschäftigt (s. *Schotti technica curiosa*); abor da dies in Engelland guchahe, und Englische Aerzte die Hauptpersonen bey den Infusionsversuchen, waren, die auf seine Veranlassung angestellt wurden, so übergehe ich ihn hier,
165. A. a. O. p. 10.
166. Es sind folgende: 1) Der Name Chirurgia infusoria sey unpassend. 2) Jeder habe ein von Gott bestimmtes Lebensziel, dessen Ueberschreitung nicht möglich sey. 3) Wenn aber der Kranke nach der. solben stürbe, 80 werde man den Arzt des Todtschlages beschuldigen. 4) Die Infusion und ihr Erfinder werde leicht Tadler finden. 5) Die Anstellung von Versuchen sey jetzt, wegen der Unfolgsamkeit der Kranken, schwer, u. 6. w.
167. S. dessen Memoriale anatomico miscellan. 1669. §. 18.
168. Wenigstens erwähnt er nirgends eines vorhergehenden Versuchs an Thieren.
169. Durch das Holunderblüthwasser glaubt er der Gerinnung des Blutes vorzubeugen, die er von anderm gemeinen oder destillirten Wasser befürclutet.
170. A. a. O. §. 29.
171. Dieser erfolgte 1693 in Schweden, aus Aergerniss über einen Ring mit falschen Brillanten, den ihm eine seiner Kranken, eine Schwedische Gräfin, geschenkt hatte.
172. In seiner Clysmatica nova. Dals Elsholz wirklich von den früheren Versuchen der Engelländer und andrer nichts gewusst habe, ist bey dem damals minder vollkommnen literarischen Verkehr sehr wahrscheinlich.
173. S. seino Centur. epistolar. und Majors Chirurg. infusor.
174. I. c. Epist. 55 und 63.
175. Hátte Maurocordatus, wie er 1664 seine bekannto Schrift über den Blutumlaut zu Bologna berausgab, so wie Mayon 1668 das Sauerstoffgas gekanht, so würde er die Ehre der ersten Erfindung der jerzt herrschendon Theorie vom Nutzen des Athembolens davon tragen; aber so leitet er die Erwärmung des Bluts in den Lungen nur von dem Drucke ab, den es dort erfährt,
176. S. Dr. Möllers Brief aus Danzig vom 27 Febr. 1666 in Majors Delic. Hybern. Ettmüller nennt acht Gran Scammoniumliarz in drey Drachmen Essent. Guaiaci aufgelöst.
177. Philos. Trans. N. 30. 1667. Dec. 9. Dieser Brief war 1666 im November von Hevelius an Oldenburg geschickt, s. Birch, p. 223. T. II.
178. Um diese Cur nicht zu wunderbar zu finden, erinnere man sich, dass der Kranke nach Möller schon zwey Mal die Antisyphilitische Cur durchgegangen war, und dass die Einsprützung folglich nur dio Folgen der Krankheit oder der Cur, durch die Revolution, die sie im Körper bewurkto, hob.

179. Dieser Ausdruck sagt nicht bestimmt, ob sie blos von neuem krank geworden, oder gar gestorben sey. Nach einem Briefe Oldenburgs in Boyles Works, T. V. p. 375 zu urtheilen, scheint letzteres der Fall zu seyn.
180. Philos. Tran. N.39.
181. Ob in diesen beyden Versuchen der vorige mit einbegriffen is, lafst sich aus Mangel der genaueren Bestimmun sich entscheiden.
182. Birch, II. 341.
183. Transfus. sanguin histor.
184. Sanguinea apollineae palaestrae acies.
185. Oldenburg erzählte zwar (Birch, II. p. 227) von Transfusionsversuchen, die man zu Wien an mehreren Hunden mit guten Erfolg angestellt habe, von denen unter andern einer, der vor Alter kaum mehr gehen konnte, durch das Blut eines andern robusten Hundes wieder sehr zu Kräften gobracht wurde. Da aber kein andrer Autor dieser Versuche erwähnt, so veriuthe ich, dass dies nur die zu Udine angesteilren Versuche sind (von denen ini der Folge), die Oldenburg von Wien aus gemeldet worden waren,
186. Purmann chirurg. Lorbeerkranz, p. 284. 285. und Chir. curiosa, p. 712.
187. Purmann Chirurgia curios. T. III, C. XVI.
188. In letzterer Schrift spricht er auch von der Kunst, durch chemische Mittel kleine Menschen in Gläsern auszubrüten.
189. Klein Sanguinea Apollineae palaostrae acies etc. 1680.
190. Parerga anatom. Ed. Tert. p. 259.
191. A. a. O. p. 161.
192. Paeonis et Pythagorae, i. e. Peyeri et Harderi exercit, anat. p. 193.
193. S. dessen Apiarium obs. p. 14. Obs. VII.
194. Parerga anatom. Paeonis et Pyth, p. 233. 263. und Apiarium, Obs. 25.
195. Act. Nat. Cur. Dec. II. An. 7. Obs. 132.
196. Brunner Exper. nov, circa paucreas, 1683. Amst. p.21.
197. Acta Nat. Cur, Dec. II. An. 8. Obs, 131,
198. Chịr. Lorbeerkranz.