ETUDES HISTORIQUES, PHYSIOLOGIQUES ET CLINIQUES SUR LA TRANSFUSION DU SANG

By: Dr PIERRE CYPRIEN ORÉ (1876)

A TRANSLATION OF PAGES 1 - 61 BY PHIL LEAROYD

A copy of 'Historical, physiological and clinical studies on blood transfusion' by Pierre Cyprien Oré, originally published in 1876 in Paris [by J-B Baillier & Sons] can be viewed or downloaded from the following site:

https://books.google.co.uk/books/about/Etudes_historiques_physiologiques_et_cli.html?id=1KovAQAAMAAJ&redir_esc=y

NOTE: This is the second book that Pierre Cyprien Oré wrote on blood transfusion; his first, 'Historical and physiological studies on blood transfusion' was published in 1868. This 1876 book is not a reprint with a different title but has a different, more extensive content, being over 700 pages whilst his 1868 book had less than 200 pages.

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

I have included the same italics in this translation as they occur in the original text, which are used by the author to draw attention to that part of his presentation. In addition, I have not changed the spelling of the names of people or institutions identified by the author, the spelling is his own. I have however in a small number of places included words in square brackets to explain a particular term used by the author. I have also not changed the wording of the references, keeping them in their original language / format. Oré does however somewhat confusingly in this book place some of the references in brackets within the text whilst also referencing others by number and placing the references at the bottom of the page. Being unable to maintain this format in this translation I have placed all references within the body of the text.

The historical section of the book is presented in three time periods, as it is in his 1868 book, though he has modified the first to be 'Antiquity – 1668' rather than being '1665 – 1668', which is more appropriate considering that in his 1868 book, the author included pre-1665 material within his 'first-period'. Oré has also updated the second period (i.e. '1668 – 1818') so that instead of basically being 'blank' he has included some of the limited research that was conducted during this period,

especially that of Michel Rosa in Italy. The final period (i.e. 'from 1818') has obviously been extended to include information relating to the period up to 1876. However, this takes the form of somewhat detailed information about the research carried out by different investigators of that period, e.g. Dieffenbach, Bischoff, Polli, Brown-Séquart and others and as such means that the 'history' section abruptly changes to what would have been more appropriately called 'recent research'. I have not translated this material.

As what would be expected, Oré has kept a large amount of text from the historical section of his 1868 book (it obviously hadn't changed during the intervening period!) but he has also revised, omitted or added material, so that it is not a straightforward 'reproduction'. The author has for example modified the information relating to the trail involving Denys on the 9th April 1667 and also identifies that it was essentially Meklin in his book titled: *Tractatio medica curosa de ortu et occasu treansfusionis sanguinis* (Nuremberg, 1679) who as an individual condemns transfusion in the name of the Church, rather than the Catholic Church itself – information that is not included in his 1868 book.

The 'Pathological History' of transfusion, which forms 'Part 2' of the historical section of the 1868 book has been completely re-written so that it is produced from the viewpoint of 'observations', i.e. the research work performed by different people as well as the results of the research made into the different aspects of transfusion (e.g. coagulation, defibrination, air embolism, etc.) rather than the presentation of published transfusion events. This material also includes extensive information about the author's own research. Obviously, as the book's title suggests, a large amount of material relating to the use of transfusion in different clinical indications is also included. As such, Oré attempts to answer his own question posed at the end of the historical section of his 1868 book, i.e. "that many questions still exist that require answers".

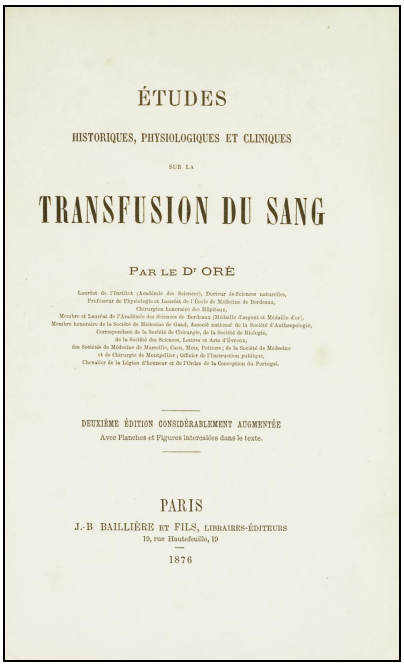
INDEX TO THE 'HISTORICAL SECTION' OF THE BOOK

A: Page number in original book; *B*: Page number of this translation

PIERRE CYPRIEN ORE (1828 – 1889)

Pierre Cyprien Oré was a French doctor, surgeon and professor of physiology at the Faculty of Medicine in Bordeaux, where he was born on the 15th November 1828 in Bordeaux. In 1850 he became a student at the medical school and then an intern at Bordeaux hospitals. His first thesis submitted in support of his doctorate in natural sciences was titled 'Experimental research on blood transfusion'. He became a surgeon at Saint-André Hospital, later becoming a professor of medicine at the faculty of Bordeaux. From 1860 he became very interested in blood transfusion research, publishing the first edition of his book 'Études historiques et physiologiques sur la transfusion du sang' [Historical and physiological studies on blood transfusion] in 1868, the second, much revised edition, being published in 1876. He later however experienced a number of practical blood transfusion failures and as a result, ceased this line of research, retiring from his teaching post in 1878. He continued to practice for ten years as a simple doctor. He was a corresponding member of the Savoy Academy of Sciences (1884-1889) and the National Academy of Medicine (1885-1889) as well as a Knight of the Legion of Honour. He published extensively on other medical subjects and was in 1872 the first person to successfully administer intravenous anesthesia (chloral-hydrate) and in 1875 published the first monograph on intravenous anaesthesia in humans. He is stated to have been an amateur painter and poet as well as a collector, especially of ceramics. He died in Bordeaux on the 5th September 1889.

Pierre Cyprien Ore
(image credit: docplayer.net)



ÉTUDES

HISTORIQUES, PHYSIOLOGIQUES ET CLINIQUES

SUR LA

TRANSFUSION DU SANG

PAR LE Dr ORÉ

DEUXIÈME ÉDITION CONSIDÉRABLEMENT AUGMENTÉE

Avec Planches et Figures intercalées dans le texte.

PARIS

J.-B BAILLIÈRE ET FILS, LIBRAIRES-ÉDITEURS

1876

'Transfusion du Sang' (1876)
(image credit: adebooks.co.uk)

INTRODUCTION

Transfusion is an operation that involves passing blood from the vessels of one animal into those of another. Recommended towards the beginning of the second half of the 17th century, it was greeted with genuine enthusiasm. Doctors, poets, philosophers, saw it as an infallible means of easily triumphing over diseases, of giving strength to those who lacked it, of fighting against the ravages of time; in a word, it was to bring about the complete regeneration of humanity. But if transfusion had the privilege of having ardent supporters, it also had, from its appearance, violent antagonists, and thus suffered the fate reserved for all the great things. To be convinced, it suffices, to throw garlic on the writings of time. We read, in fact, in the *Dictionary of Sciences of Neufchatel* (vol. XXVI, p. 517.): "We fought at first with such frivolous reasons on both sides, and if we had left it there, this dispute would not have left the dark confines of the schools; but soon the scene was bloodied: the blood flowed, not, it is true, that of the combatants, but that of the animals and men who were subjected to this operation."

Experiments naturally had to decide this important issue, but no further progress was made after having made them. Each concealed the results, according to his opinion. While, according to some, the patient who had undergone the operation was cured of the madness and appeared in various places, others ensured that the same patient had died at the hands of the operators, and had been secretly buried. Finally, the spirits, embittered by the argument, ended up insulting each other. The verbose La Martinière, an opponent of the transfusers, wrote to ministers, doctors, magistrates, priests, ladies, the whole universe, that transfusion was a barbaric operation, coming out of Satan's store; that those who exercised it were executioners who deserved to be sent among cannibals, Jerusalem artichokes, parables, etc.; that Denys, among others, surpassed in excellence all those he had known: he reproached him for having played the puppets at the fair. On the other hand, Denys, at the head of the transfusers, called those who thought otherwise *jealous, envious, wretched*, and called La Martinière a miserable tooth-puller and operator of the Pont-Neuf.

The court and the city soon took sides in this quarrel; and this question, which became the news of the day, was stirred in circles with as much enthusiasm, as little common sense and less knowledge, as in the schools of art and the offices of scholars. The dispute began to fall towards the end of 1668, following a sentence handed down to the Châtelet, which forbade, under penalty of prison, to perform the transfusion on any human body, that the proposal had not been received and approved by the Faculty of Medicine of Paris.

More than two centuries have passed since the sentence of the Châtelet. In turn abandoned and revived, blood transfusion did not make a fortune, and the severe judgment against it in 1668 was still in favour in 1863, when I published my first research. Without multiplying the quotations, I will recall, as evidence, the opinions expressed, in their writings, by the men who have rightly occupied a considerable surgical position.

In his *Treatise on Surgical Medicine*, Velpeau makes no mention of blood transfusion.

Mr. Chassaigoac, in his book titled: *Traité Clinique et Pratique des Opérations Chirurgicales* expresses himself thus: "Without blaming in an absolute way the attempts that have failed from the point of view of transfusion, *we believe that one should always hesitate to perform an operation that has almost no chance of success.*" (T. I, 408, Paris, 1861.)

Mr. Alphonse Guérin is even more opposed: “Up to now” he said, “transfusion must be regarded as an operation much more dangerous than useful.” (*Éléments de Chirurgie Opératoire*, Paris, 1853, p. 83, 2nd Ed.)

One might hope that the facts published since 1853, when Mr. Guérin formulated such an unfavourable opinion against transfusion, would have shaken his hostile convictions; it has not happened: "Don't think I'm here to defend," Mr. Guérin said in 1872 at the Bordeaux Congress, "the operation condemned by the Châtelet. At the risk of displeasing some of my listeners, I will say right away, so that we know what to expect, that I come to fight transfusion as it has been operated so far. If bold minds tried it, it was because they had nothing better." To replace it, Mr. Guérin proposed a method which he found and thought was infinitely preferable to him: "*the community of blood*." (*French Association for the Advancement of Science*, 1st session, 1872, p. 51.)

Since that time, thanks to experimental physiology, blood transfusion has entered a more fruitful path. Everywhere, in France, England, America, Germany, Italy, Denmark, Sweden, Russia, the most eminent physiologists and clinicians have made it the subject of their studies. Efforts have been made to better clarify the elements of the problem, to resolve objections, to fully appreciate the indications and contraindications, and finally to make the operating manual easier and free of danger by creating various instruments that, by improving more and more each day, inspire the surgeon with confidence and safety.

It is to tracing the history of this progress that I dedicate the following pages.

When I published my research on transfusion thirteen years ago, I had to respond to a wish made by Mr. Larrey in the heart of the Society of Surgery; by completing these first studies today, I am only giving in to a desire that this eminent surgeon recently expressed to me.

I will divide this book into four parts: In the *first part,* I will tell the physiological history of blood transfusion;

In the *second part,* I will report all the transfusion operations performed on men or women from the year 1820 to the present day;

In the *third part,* I will study the indications, contraindications, complications, accidents, etc., of transfusion;

Finally, I will devote the *fourth part* to the study of the operating manual and the many instruments that have been proposed in turn.

In this way, I hope that I will be able to make as comprehensive a presentation as possible of this important issue.

This is my most ardent desire and the goal towards which all my efforts will be directed. Is blood transfusion not part of this great therapeutic method to which, I am convinced, the future belongs: the *direct introduction of medicinal substances through the veins*.

PART ONE
PHYSIOLOGICAL HISTORY OF BLOOD TRANSFUSION

In 1863, I wrote the history of blood transfusion, which was published in the *Mémoires de la Société des Sciences physiques et naturelles de Bordeaux*. (1863, B.C. Ballière) I quoted, in support, the documents that I thought were the most authentic. Since that time, much work has been undertaken on the same subject, and most of the authors have reproduced my history, in whole or in part. This allowed Mr. Viault to say, "The historical research on blood transfusion published in 1863 by Mr. Oré left almost nothing for his successors to do, who almost all, have more or less drawn heavily on his Memoir." (*Etude critique sur la Transfusion du sang*. Paris, Thesis, 1875, n° 411, p. 9.) Some, the largest number, were quick to point out the source from which they drew. Others, on the other hand, made no mention of it. I thank the former; I will not imitate the latter.

I know nothing more respectable than scientific property and good faith; so, in completing this history today, I will consider it a duty to point out, with the new documents, the names of those to whom I have borrowed them.

I divide the history of transfusion into three periods.

The *first* extends from antiquity to the year 1668. In this period, the marvellous first holds a large place; it is only, in fact, starting from the discovery of the circulation of blood, that transfusion enters a more serious path.

The *second period,* or period of abandonment and forgetting, goes from 1668 to 1818.

The *third period,* finally, a truly scientific period, based on experimentation and clinical practice, begins in the year 1818, and continues to the present day.

FIRST PERIOD

Did the ancients know about the transfusion of blood?

It is easy to demonstrate that the possibility of transfusion had been foreseen by the ancients. There's proof of that in:

1. *The History of the Ancient Egyptians* where we see that these people practiced it for healing their princes.
2. *The Book of Wisdom* of Tanaquila, wife of Tarquin the Elder, where it is said that she used transfusion.
3. *The Treatise of Anatomy of Herophilus*, where it is spoken of quite clearly.
4. A collection of a former Jewish writer, which was shown in La Martinière by Ben-Israel Manasseh, rabbi of the Jews of Amsterdam, in which can be found the following words: "Naam, prince of the army of Ben-Adad, king of Syria, suffering from leprosy, used doctors *who, to cure him, removed some blood from his veins and put in more*."
5. The *Sacred Book of the Priests of Apollo,* where this operation is mentioned.
6. The research for the Eubages.
7. The works of Pliny and Celsus, which condemn it.
8. *Ovid's Metamorphoses.* It is in Ovid that we encounter the first ideas regarding the transfusion of blood. However, says Dr. Joseph Casse (*De la Transfusion du sang.* Bruxelles, 1874, p. 7), should we consider as belonging to its origin the passage from book VIII of Metamorphosis (p. 284), where Medea, yielding to the prayers of the son of Eson, rejuvenates him?

   Stricto Medea recludit
   Ense senis jugulum; veteremque exire cruorem
   Passa, replet succis.....

   Succis, that is, the blood of a black sheep boiled with seeds, flesh and wings of the stryx, wolf entrails, etc., etc.; and no sooner had she watered Eson's *mouth and wound*, than he regained the vigour he had enjoyed twenty years before. The following passage (verse 332) is clearer:

   Quid nunc dubitatis inertes?
   Stringite, ait, gladios, veteremque haurite cruorem,
   Ut repleam vacuas juvenili sanguine venas.

   But here the result is different from the first (verse 347):

   Plura loquaturo cum verbis guttura colchis,
   Abstulit, et calidis laniatum mersit ahenis.

   So it was only a crime, what Medea wanted in urging the daughters of Pelias to kill their father, and by promising to do so she would give him back his early youth.

There is obviously, in these two passages, only the marvellous, and it cannot be seriously admitted that Ovid saw the possibility of employing an operation such as transfusion to revive life.

9. The *Treaty of Sacrifices of Emperor Julien,* of Libavius, where the author speaks of transfusion, as having been an eyewitness of an operation of this kind.
10. Finally, Marcel Ficin, Father Trithème, Aquapendente, Harvée and Fra Paola had experienced it themselves (Letter from La Martinière to M. de Colbert.)

All these quotations prove that the ancients had glimpsed the possibility of transfusion; perhaps even this operation had been performed. However, it is worth adding that we find in the authors only vague and uncertain indications about intending to perform an operating procedure.

It was in the fifteenth century that we find the first vestiges of the operation.

We read, in fact, in the *life of Jérôme Savonarole,* by Villari, this fact mentioned by Sismondi: "The strength of Pope Innocent VIII was failing fast. He had, for some time, been plunged into such drowsiness that, at times, he seemed dead. All means of awakening his exhausted life had been used, when a Jewish doctor proposed to obtain the sought result by transfusion, by means of the blood of a young person, a means that had hitherto only been tested on animals. So the blood of the old and weak pontiff was exchanged for that of a young man. It was repeated three times, and the experience cost the lives of three young men; *probably air had entered their veins*; but no effect was achieved; the pope was not saved, he died on 25 April 1492." (Raynaldi, *Anneles ecclésiastiques*, 1492. – Marmonier, *Thèse inaugurale*, Paris, 1869. – Jullien, *Thèse pour l'agrégation en chirurgie*. 1875, p. 3.)

This quote offers a twofold interest. It shows that, as early as the fifteenth century, the transfusion of blood had been performed on a man with human blood. It then shows that, at that time, it was assumed that the entry of air into the veins was capable of causing death. I do not believe that any Treatise on Surgery has ever mentioned this fact, which has always been considered to belong to our century.

In a book on the origin of transfusion, titled: *Relatione de l'experiense fait in Englaterra, Francia, etc.*, the author quotes a text of Libavius where transfusion is perfectly described from the year 1615. Here is the passage:

Adsit juvenis robustus, sanus, sanguine spirituoso plenus; adstet exhaustus viribus, tenuis, maculentus, vix animam trahens; magister artis habeat tubulos inter se congruentes, aperiat arteriam robusti, et tubulum inserat, muniat; mox et ægroti arteriam findat et tubulum fæmineum infigat. Jam duos tubulos sibi mutuo applicet, et ex sano sanguis arterialis, calens et spirituosus, salicet in ægrotum, unàque vitæ fontem afferet, omnemque languorem pellet. (Libavius, *Appendix necessaria stygmatis ascanarum chymicorum,* ch. IX, p. 7. An. 1615.)

The author adds that Libavius proposes this operation only to make fun of it; because, on the request of what must be done to prevent the person who supplied the blood from falling into weakness, he says that it is necessary to think instead of what will be done to cover the doctor who advised this operation, and that, for him, he is of the opinion that we give good broth to the one who has supplied the blood for the transfusion, and hellebore to the doctor who will have ordered it. Sed quommodo ille robustus non languagescet; danda ei sunt bona confortantia, et ubique inedico vero helleborum. *(Journal des Savants,* Monday, July 2, 1668, p. 37.)

In 1628, Giovanni Colle of Padua, when speaking of foods and medicines suitable for prolonging life, mentions transfusion as one of the means to achieve this goal. From medicinal infusion to that of perhaps the most heroic of drugs, there is really only one step. Anyway, he writes: *Denuo insurget aliquis, frustra hæc esse tentanda, dum per pauciora æque et bene valenus consequi optata, veluti si quis e vena exhibens juvenis admodum salubris, per fistulam senis permeet, insufflante juvene et sene attrahente et inspirante; ut sanguis juvenis intus attrahatur a sene et ne hujus*

egrediatur. Nam hic sanguis potest reparare humidum primigenium temperamentum. (*Methodus facile parandi tuta et nova medicamenta*.)

We will repeat, with J. Casse, that this is still only an imprecise and vague idea of transfusion.

The same is not true of the following passage, borrowed from a talk given to Ferdinand II of Tuscany by Francesco Folli of Sappi. This talk was about his intention to do the transfusion. He wrote in 1652: I read William Harvey's book, which deals with the movement of the heart and that of the blood. This reading, with some notions I had about plant transplantation, produced in my mind this third problem, that the blood circulation being given, it would be possible to make the transfusion, by which one could not only heal, but rejuvenate and become robust. Folli used two cannulas for transfusion, one made of bone, the other of silver, which was to be inserted into the patient's vein. These two cannulas were joined by a bladder, a piece of intestine or even a prepared artery, having a collateral in its path, through which the air, which could be contained in its interior, had to escape. According to his research, there was no need to press the middle part of the two cannulas so that the blood entered easily.

Mr. Casse concludes from this passage: "It is therefore to Folli that we owe this important discovery, the honour of which, once again, goes to Italy. (*Loc. cit.*, p. 10.)

If the fact relating to Pope Innocent VIII is correct, and there is no reason to believe that it is not, it is not possible to grant Folli the honour of discovery. Moreover, I find it very difficult to decide this issue of priority, as we will see later.

The transfusion had therefore been foreseen by the ancients; but it was not until the beginning of the second half of the seventeenth century that it began to take its place among the regular operations of surgery. From that moment on, we are no longer limit ourselves to statements, to more or less imaginary comments: we attempt tests, first on animals, then on humans. The discovery of the circulation on the one hand and the application of the experimental method on the other, were to lead to the solution of the problem. What I have said about the quarrels to which it gave rise will explain the claims of the English, French and Germans to the priority.

The French surgeons of that time, while granting the English the honour of having been the first to experiment on animals argue that in France, and before Richard Lower's experiments, which were made in 1666, *the first idea of transfusion was born*. Thus, says Denys, in a letter to M. de Montmor, it is known, and there are several persons of honour who can testify, that it was more than ten years since Dom Robert des Gabets, a Benedictine cleric, gave a speech on transfusion, in the assembly held at Mr. de Montmor's house. Mr. Chereau, in a note (*Union médicale,* p. 374, 1874.): "*On two points in the history of transfusion*", recounts the text of the very words spoken by Dom Robert des Gabets in this meeting: Dom Robert des Gabets having been invited to speak (one day in July 1658), astonished all present by enunciation of very surprising ideas, indeed, and which had been germinating for a long time in his mind; recalling Harvey's very recent discovery of the circulation, he asserted that another movement of blood could be induced, which he called *communication*; by this word he meant "the effective passage of the blood of a healthy man or some other animal into the veins of a weak or sick man..." "If", he added, "having bound a man's arm as if to bleed him, they open his vein above the ligature, towards the shoulder, and insert a small pipe into the opening of the vein, the foreign blood that would be pushed and received into this pipe would enter the vein, would go to the heart by the ordinary way, from there would pass through the arteries, and would distribute itself to all body." Dom Robert des Gabets exclaimed moreover, convinced: "You have, gentlemen, in Paris, in Saint Martin-des-Champs and in Saint-Denis-de-la-Chartres, with whom I lived in Cluny, and one of them, named Dom Éloy Pichot, who made me do for Mâcon seven years ago (1651), the pipes I had asked him to make for the *communication*. The machine I invented was very simple. For that, I only need two small silver pipes joined together by a small

leather purse the size of a walnut; these pipes each have a valve at one end so that, by gently pressing with both fingers on the leather pouch, the blood to be communicated already enclosed in the pipe can no longer enter the vessel, nor can it come out of the pipe inserted into the other vessel. The leather pouch still has the advantage of ensuring the quantity of blood released."

An answer to the above can be found in a passage borrowed from the *History of Philosophical Transactions*, where it says: "We readily agree in England that the French were the first, as far as we know, to make this great step of transfusion, *to practice it on man*; but they must also learn the truth, which is that that philosophers in England have long since made this experiment on men, if they were not so circumspect when it comes to putting to chance the life of a man, for the preservation and recovery of which they however spare no care or punishment, and if they had not been restrained by the fear of a law which is more precise and more rigorous, in similar cases, than the laws of several other nations." (Abstract of the *Philosophical Transactions of the Royal Society*, Part 6, 1790, p. 369.)

The English and French were not the only ones who took part in this struggle over the question of priority. A German, Jean-Daniel Major, maintained that he was the inventor of transfusion. Although his writings did not appear until 1667, if they were made by him and if they are true, it is indisputable that he was the first to perform transfusion on man. It reads that he drew three or four ounces of blood through the arm vein of a very weak man; that he then untied the ligature and re-applied it below the wound, so that that the blood of a healthy person could penetrate, without mixing with the one contained in the lower part of the vessel; then he pricked the vein of the healthy individual, and covered the wound, lest the air should decompose the blood. To this end, he used a vessel similar to a suction cup, from which this fluid could flow: he had taken care beforehand to spread ammonia salt therein, in order to prevent the blood from clotting. (Sprengel, *History of Medicine,* t. IV, p. 122)

It is difficult, from the above, to assign to which, French, English, German, surgeons belongs in absolute terms, in this matter, the most indisputable rights to priority; but what is quite certain is that Richard Lower was the *first to make known a complete procedure for carrying out the transfusion*, in a letter addressed to Robert Boyle, which he was instructed to communicate to the Royal Society of London. Before him, Christophe Wren had already proposed the experiment of infusion of drugs into veins. Shortly after the discovery of infusion, members of the Society added that of transfusion. It was resolved to attempt it at a public session in May 1665; but the operation was not successful, due to the lack of a convenient device and a well-directed process. It was then that Richard Lower made known the following process, which he first put into practice at Oxford.

Extract from the Journal of England* containing how to pass blood from one animal into another

[*Philosophical Transactions of the Royal Society]

Here's how Richard Lower expresses himself when he addresses Robert Boyle: "First, you have to take the carotid artery of a dog or any animal that you want to get blood from into another's body, and, having separated it from the nerve of the eighth conjugation, keep it uncovered by about an inch; then, make, in its upper part, a strong ligature that cannot be untied, and an inch below, to go towards the heart, make there yet another ligature that can tightened or released as necessary. These two knots being made, pass two threads under the artery between the two ligatures; then open the artery, and put a small quill pipe into it, and tie the artery tight with the two threads over that pipe, which you will plug with a small cap. After that, uncover the jugular vein of the other animal by an inch and a half, and make a slipknot at each end, and between these two nooses pass over the vein two threads, as in the

artery; then make an incision in the vein, and insert two pipes there, one in the lower part to receive the blood of the other animal and carry it to the heart, and the other pipe in the upper part, which comes from the test, through which the blood of the second dog can flow into dishes. With these two pipes in place and being tightly tied, keep them plugged with a cap until it is time to open them."

"With everything thus prepared, tie the dogs to each other on the side, so that more pipes can be passed through the first two; because, as we cannot approach the necks of the dogs close enough to each other, we must put two or three different pipes in the first two to carry the blood from one to the other. After that, uncork the pipe that goes down into the jugular vein of the first dog, and the other pipe that comes out of the artery of other dog; and by means of two or three other pipes, as necessary, join them to each other, then let go of the slipknot, and immediately the blood will pass impetuously through the pipes as through an artery, and at the same time as the blood flows into the dog, uncork the other pipe that comes from the upper part of the jugular vein (having previously made another ligature around its neck, or at least pressing with the fingers the other jugular vein), and at the same time let the blood flow into the dishes (not continuously, but depending on whether you judge that his strength will allow it) until the other dog begins to scream, to weaken, to fall into convulsions, and at the end die on that side."

"Then pull the two pipes from the dog's jugular vein, and having tightened the slipknot, cut the vein above (which can be done without any harm to the dog, because one of these jugular veins is sufficient to conduct all the blood from the test and the upper parts, because of a large anastomosis through which the two veins unite towards the larynx). That being done, sew up the skin, and let go of the dog, which will jump off the table and shake himself and run away as if nothing had been done to him." (*Journal of the Savants*, Monday, January 31, 1667, p. 21.)

In the same year, Denys, professor of philosophy and mathematics, wrote a letter to M.*** in which he recounts some experiments that he has made on animals: "On Thursday, March 3", he said, "they brought to us, Mr. Emmeretz, our surgeon, and to me, two small dogs that had never been fed together, and which, in their faces, seemed as different as are some animals of different species, one being a pet spaniel bitch and the other a short-haired dog resembling a fox. The bitch was full and a little bigger and taller than the dog, because she was twelve inches tall and the dog had none only ten."

"We proposed to do, not only was what was written in (Richard) Lower's letter, which is to pass the blood of one animal into another, by killing the one who communicates it to preserve the other who receives it, but we wanted to keep them both, and for this we resolved to open the crural artery of the bitch, persuading ourselves that by drawing the blood through the artery that carries it from the thigh to the extremities, the convulsions would not be so much to be feared for the bitch, as by pulling it by the carotid which carries it through the neck to the brain, besides the crural artery is not so loose or so depressed as the carotid, we would not be obliged to use such loose pipes, which are liable to clogging up when the blood passes through them, and the bitch does not suffer so much, it would be easier to make her escape."

"Indeed, the thing happened in the presence of several worthy people, as we had foreseen, and in a fairly simple and easy way."

Denys emphasizes how the pipes were placed in the crural artery and jugular vein. The process is similar in this respect to that of Richard Lower; he was thus able to pass the blood from the artery into the vein, which at the same time as it flowed through the vein, using a third pipe, blood was collected in a dish.

"When we had drawn nine ounces of dog's blood through this third pipe into a dish," continues Denys (which is a lot for an animal of this size), "the bitch who had given him so much, and who therefore had little left, began to weaken; therefore we

immediately stopped its artery, squeezing the slipknot; and after having also made two strong ligatures to the dog's jugular vein, instead of two slipknots we had made there, we detached the dogs, and here is what we noticed in particular:"

"The dog, who had communicated her blood, was weak enough and had only the strength to go into a corner of the room, on the side that had not been opened; but for the dog who had received new blood, he made several efforts to tear off a muzzle which had been put to him to prevent him from screaming, and, after shaking a little, he immediately fled from those who wanted to approach him, because of his naturalness which is quite fierce. The two dogs that had been used for the transfusion ate very well two hours later, and ate much more than a third that had been prepared only for this operation."

"I have kept these dogs, and their vigour has maintained and increased day by day, in proportion to their appetite, we did not notice that there was reason to fear any bad success of this blood transfusion. The bitch eats extraordinarily, and she has now given birth to a small dog, which was born dead, and in which only three or four drops of blood have been found."

Denys also recounted a new experience he had on the following 8th March; he used the dog that had been transfused in the previous experiment, and passed his blood into the dog that had not been used; it brought the first to a halt, and weakened him so much *that he seemed* dead; the blood he had lost could be estimated at twelve ounces, for that which, collected in the dish, which had been supplied by the second, amounted to that quantity. The two dogs escaped perfectly, and after some considerations of the conditions that must be achieved by performing the transfusion, Denys finishes his letter:

"All this happened with great astonishment to those who honoured us with their presence, and especially of a very skilful doctor of medicine, who ingenuously confessed that he would never have believed it if he had not seen and examined all the circumstances himself." (*Journal des Savants*, Monday, March 14, 1667, p. 44.)

These experiments are not the only ones that Denys has done on animals; in April of the same year, he wrote to M***:

"Since the experiments I wrote to you on the 9th of the previous month, we have passed the blood of three calves into three dogs, in order to ascertain the effects that the mixture of two different bloods could produce. I will let you know more about the details in a while; now I will just tell you that the animals in which the blood was transfused are eating just as well as before, and that one of those three dogs, to whom so much blood had been drawn the previous day, could hardly move any more, having received the blood of a calf the next day, immediately regained his strength and showed a surprising vigour. We have found so many new ways of making the transfusion with ease, that Mr. Emmeretz makes a strong case for doing it without any ligature, with a puncture similar to that done in bleeding." (Excerpt from a *Letter from Mr. Denys to. M****, April 1667, 63.)

The success Denys had achieved in experimenting on animals must necessarily lead him to do the transfusion on humans. This is what happened, as we will soon see.

Other animal experiments were undertaken in England by Edmond King and Thomas Coxe. They offer this particularity, which deserves to be reported, to have been made *not from artery to vein but from vein to vein.*

"Dr. King, having drawn forty-nine ounces of blood from a sheep, and having given back about as much blood from a calf whose jugular vein he had opened, the sheep, after the operation, appeared as strong and as vigorous as before; but, as we wanted to kill it, the vein was opened soon after, and the blood was allowed to flow as long as it could flow. Sixty-five ounces were taken from it before it died; and having opened it afterwards, no more was found in the body."

"The same doctor drew forty-five ounces of blood from another sheep that was smaller, and as this evacuation having greatly weakened the animal, he gave it back

about as much calf's blood. When the sheep's wound had been closed and it had been untied, it no sooner felt itself at liberty, seeing near him a spaniel which had previously been transfused with sheep's blood, he went and gave him three or four big butts, and has been doing very well ever since." (*Journal des Savants*, June 8, 1668, p. 17.)

Thomas Coxe gave a similar *vein-to-vein* transfusion on a strong, healthy young dog, to which he infused fifteen or sixteen ounces of blood from another old scabby dog to see if scabies was transmitted with the blood. The success was that the young dog was none the worse for it, and that the scabby dog was perfectly healed in ten or twelve days, the evacuation of the blood that had been done to him was probably the cause of his recovery. (*Loc. cit.*, 1668, p. 17)

At the same time as these events were taking place in England and France, in Italy Cassini and Griffoni published experiments undertaken on this subject.

"On the 28th day of March 1667, in Boulogne, at Mr. Cassini's the experiment of transfusion was made on two lambs. The carotid artery of one was opened and blood was passed from it, without it being able to flow into the right branch of the jugular vein of the other, from which as much blood had previously been drawn as was deemed possible for a lamb of that size could supply him with, from which blood would be allowed to flow until it died. Then two ligatures were made quite close to each other, to the vein of the lamb that had received the blood, and this vein was cut entirely between the two ligatures, to see what would happen. After that, the lamb was untied, who, without appearing weaker, began to follow those who had performed this operation on him. He has lived a long time since, and his wound having healed, he grew like the other lambs, but on the 5th day of January 1668, he suddenly died, and his stomach was found to be full of rotten food. Having dissected the cervix to see what had happened to the vein that had been cut from him, it was found that it had joined to the next muscle by some fibres, and that the upper part of this vein had communicated with the lower by means of a small branch that could in someway make up for the defect of the whole trunk." (*Journal des Savants*, Monday, November 19, 1668, p. 85.)

"On the 20th day of last May, at Mr. Griffoni's house in Udine, another experiment of the transfusion of blood of a lamb into the veins of a bracque [pointer] dog, which was of mediocre size in its species, thirteen year old, and quite deaf for more than three years, so that, whatever noise was made, he gave no sign of hearing it; he walked very little, and was so weak, that he could not lift his feet, he merely dragged himself along. After he had been given the transfusion and untied, he remained for an hour on the table where he was; but then when he got down, he went to find his masters who were in other rooms. Two days later, he left the house and began to run through the streets with the other dogs, without dragging his feet as he had done before; his appetite returned too, and he began to eat more and with more greedily than before. But what is more surprising is that from then on he gave indications that he was beginning to hear, sometimes turning to the voices of his masters. On the 13th day of June, he was almost cured of his deafness, and he seemed, without comparison, more cheerful than he was before the operation; and finally, on the 20th of the same month, he had fully regained his hearing, with this defect nevertheless, that when he was called, he turned back, as if the one who called him had been far away; but this did not always happen, and yet he always heard when he was called. (*Loco. cit.*, p. 88.)

Experience having shown that transfusion is not only possible, but easy, it now remains to be seen whether it is advisable to perform it on man and whether some considerable advantage can be derived from it for the preservation of health or the cure of diseases.

Tardy, a doctor of medicine from the Faculty of Paris, in a book entitled: *Traité de l'écoulement du sang d'un homme dans les veines d'un autre et de ses utilités*, seeks to demonstrate by reasoning that this operation must succeed even better on men

than on beasts; but to avoid the inconveniences that opening the arteries would often bring, he believes that instead of transfusing from artery to vein, it would be better to do it from vein to vein (we have seen previously that Ed. King and Thomas Coxe had done so). He indicates how to do this operation and the precautions to be taken to be taken to make it successful, by passing blood from one of the veins of one man's arm into the vein of another's arm. However, he supposes that the person who provides the blood gives only the amount that is superfluous to him, because otherwise this operation would be barbaric.

For the uses that can be derived from it, he thinks that the old people and those whose vessels are full of bad humor and corrupted blood, can, by means of transfusion, protect themselves from the evils of which they are threatened and maintain their natural constitution. He also says that this operation is very useful for curing of diseases that come from acrimony of the blood, such as ulcers, erysipelas, etc. The medicines that we take, says Tardy, find it difficult to sure these kinds of diseases, because they often lose their strength before they can come to the site of the evil; but new blood, well tempered, going directly into the diseased parts by means of transfusion, should give much faster and more assured relief. Moreover, this author remakes that a man's blood is not absolutely necessary for this operation, and that that of a calf or other animal can produce the same effects.

From all the above, it follows that the transfusion of blood, performed on animals, has been followed in *a constant manner* by the happiest effects.

These results were already important; but transfusion would never have played only a secondary role if it had remained locked in the confined circle of animal experimentation. It couldn't stop there. The enthusiasm it had aroused among its supporters was too great for it not to step outside such narrow limits. The reasoning, together with the failures, gave a glimpse of the possibility, the very urgency to act directly on man. The step was undoubtedly difficult, perhaps even perilous to take; it was, however, and it is French surgeons who deserve all the glory.

We find in a letter written by Denys to M. de Montmor, master of requests, the account of two transfusion experiments on man.

Before reporting these two observations, Denys emphasizes the reasons that determined it. It is important to make them known. If they are not always based on exact physiological facts, they have at least a remarkable character of originality.

"By performing transfusion," says Denys, "we are merely imitating the example of nature, which, in order to feed the fetus in the mother's womb, the mother's blood is continuous transfused into the child's body through the umbilical vein. To be given a transfusion is nothing more than feeding oneself by a shorter route than usual, that is to say, putting ready made blood in one’s veins instead of taking food that only turns into blood after several changes. This abbreviated way of feeding is preferable to the other, in that the food taken by the mouth, having to go through several parts that are often ill-disposed, can contract several bad qualities before arriving in the veins; it is subject to several alterations, which are immediately avoided by putting perfect blood in these veins; moreover, this operation brings together the doctors who approve of bleeding and those who do not approve of it: these, because, it removes corrupted blood, and those, because, by putting new blood in place of the one being drawn the patient’s strength is not diminished; and finally reason seems to teach that the diseases caused by inclement weather and corruption of blood must be cured by the transfusion of pure and well-tempered blood.”

After responding to those who condemn the transfusion as useless, Denys responds to those who condemn it as barbaric:

What gives them this opinion is that they imagine that, in order to do the right thing, the animal that provides the blood must be of the same species as the one that receives it, and thus can only prolong the life of one by shortening that of the other. But Denys makes it obvious that this is not necessary, and that on the contrary the blood of animals is better for men than that of men themselves. The reason he gives

is that men, being agitated with various passions and little regulated in their way of living, must have a blood more impure than the beasts, which are less prone to these disturbances, and that indeed there is little corrupt blood in the veins of the beasts, instead of always noticing some corruption in the blood of men, no matter how healthy one supposes them to be, and even in the blood of small children, because having been fed from their mother's blood and milk, they sucked corruption with food. Moreover, Denys adds, why should the blood of the beasts not be peculiar to men, since it is of the same species as the milk and flesh from which they usually feed? It could be added that, what some authors have noticed is true, that barbarians who feed on human flesh are subject to several unfortunate diseases of which those who feed on animal flesh are exempt, it must be concluded that since the flesh of men is more unhealthy than that of animals, their blood is also less suitable for transfusion.

All these reasons serve as a preamble to the two transfusion operations performed on humans.

The first was made on a young man of sixteen, who, following a fever that had lasted two months, and in the course of which he had been bled twenty times, had remained in a stupor and drowsiness. Denys drew three ounces of blood and transfused him with nine ounces of arterial lamb's blood. This young man lost three or four drops of blood through his nose, and then he became calm again; his sleep ceased to be restless; he gained more strength and agility in the limbs, gained weight, and kept getting better and better until he was fully recovered.

This first experiment had fortunately succeeded, Denys attempted a second, but more out of curiosity than out of necessity, for the individual on whom it was performed had no indisposition: he was a strong and robust chair-bearer, about forty-five years old, who, for a rather small fee, offered to endure this operation. As he was well and had plenty of blood, he was given a much larger transfusion than the first; about ten ounces of blood was taken from him, and about once as much blood was given to him from a lamb whose crural artery had been opened to diversify the experience. This man, who by his nature was quite cheerful, was in a very good mood throughout the operation, made several reflections, according to his scope, on this new way of caring for which he could not admire the invention enough, and complained of nothing, except that he felt great heat from the opening of the vein to under the armpit. As soon as the operation was done, he could not be prevented from dressing the lamb from which he had received the blood; then he went to find his friends, with whom he drank some of the money he had been given; and notwithstanding that he had been ordered to rest for the remainder of the day, and that he had promised to do so, at noon, finding an opportunity to earn money, he carried his chair as usual for the rest of the day, assured that he had never done so well; and the next day he begged that there would take no one else other than himself if they wanted to repeat the same operation again. (*Loco. cit.*, p. 95.)

The consistently successful results observed in animals, and the two successes achieved in humans by transfusion, should have converted the opponents of this operation, or at least temporarily silenced them; this was not the case. No sooner were Denys' experiments known than the anti-transfusion agents were energetically attacking transfusion, not with facts, but with reasoning.

In a letter written to M. Moreau, doctor of medicine at the Faculty of Paris, E. Lamy speaks out against transfusion.

He argues that this operation is more a new way of tormenting the sick than of curing them, because the diseases which it is said to be able to serve as a remedy are precisely those that come either from *the excessive heat of the blood or from its corruption*.

In those caused by too much heat, transfusion cannot take place; because the blood that is transfused, being warmer than the patient's own blood will increase the heat of the patient's own blood far from diminishing it; it will not be more useful in diseases that come from the corruption of blood, because the little foreign blood that

is received by this operation will rather be corrupted by all the mass of blood that is in the body of the patient, than the weathering of the whole mass of blood will not be corrected by this little foreign blood; for if the corruption of the blood of a rabid or miserable animal is so great that a little scum or small vapour that comes out of its body through perspiration is capable of infecting the whole mass of blood of an animal that is doing well, how would a little foreign blood not be infected by the mixture of all the blood of an animal that is attacked by these diseases?

Lamy not only thinks that blood transfusion is unnecessary, he also believes it to be pernicious and capable of giving rise to diseases; because, as the blood of a calf or animal of any kind is composed of several different particles intended to nourish the different parts of its body, he asks, if this blood passes through the veins of a man, what will become, for example, of the various particles of this blood that nature had intended to produce the horn?

Secondly, as the spirit and customs ordinarily follow the temperament of the body, and the temperament of the body depends particularly on that of the blood, it is feared that the blood of a calf, transfused into the veins of a man, also communicates to him the stupidity and brutal inclinations of that animal. (*Journal des Savants,* 1667, p. 10.)

Gadroys responded to the arguments presented by Lamy, in a letter to Father Bourdelot:

He first of all, he opposes Lamy's reasoning with experience, to which everything gives way. There is no longer any question in physics and medicine, in fact, of knowing whether an animal can feed on the blood of another animal of different species, since two dogs who had been given calf's blood eight months earlier were still alive when he wrote, and a small spaniel, which was languid in old age, after receiving the blood of a kid, not only was, but was so to speak, almost rejuvenated. Then, responding to Lamy's objections, he points out:

1. That although the blood that is transfused appears warm to the touch, it can nevertheless still refresh; just as a veal broth does not fail to refresh, although it feels warm when swallowed
2. That, as for the observation that a little foreign good blood put with a large amount of corrupted blood cannot correct its bad weathering, does not prove that the transfusion is useless, because one can drain as much blood as you would like, before transfusing it again, and that, therefore, nothing will prevent a large quantity of common good blood from being put in the veins;
3. Let us not be afraid that the horns may come to those who have been transfused with calf's blood, or that the brutality of this animal will be communicated with its blood, since it is not feared that the same accident will happen to those who take cow's milk.

Finally, to confirm the usefulness of transfusion, he reports an experiment on a patient reduced at the last extremity. It had already been three months since he had eaten, he had lost consciousness and speech, and the doctors who treated him had abandoned him; however, after the first transfusion of about two paddles of blood, his pulse rose immediately, his flow of wind stopped, and his speech returned as well as knowledge. We were already beginning to imagine some hope for his health; but after being twenty four hours in this state, he relapsed into the same symptoms as before. A second transfusion restored his vigour; nevertheless, it did not last long, for he died about twelve hours later, and it was recognized, by the opening of his body, that he could not have lived any longer, all his intestines were found to be gangrenous. (*Journal des Savants*, 1668, p. 11)

Gurge, Sieur de Monipolli, took part in this discussion, and in a letter to Father Bourdelot he said that we must strike a balance between the two opposing opinions which we have spoken of so far. According to him this operation is not as safe nor of

such great use as some claim; but it is not completely useless either, much less pernicious, as others assert. It is a doubtful remedy, which can produce good effects if it is correctly administered and can have very unfortunate consequences if it is not used with great care.

For his part, Lamy wrote again to Moreau in response to Gadroys' objections; but his answers are merely a repetition of the arguments set out in his first letter.

At the same time, a work by Eutyphronus, philosopher and physician, was published with the title: *De nova curandorum morborum ratione per transfusionem sanguinis dissertatio*, in which the author refuses to recognise transfusion. He does not care that, in order to allow transfusion, it has been argued that it is an abbreviated way of feeding by putting ready made blood in the veins, instead of having fun doing it in the ventricle; he says that it is indeed the shortest route, but not the safest, and that it is almost as if a person who is on a third floor, wanting to come downstairs, did not bother to go down the stairs, but took the shortest path would jump out the window; for nature has shown no other way to drive blood through the veins than to pass it into the ventricle, there is temerity in taking other paths.

The author points out, moreover, that it is to overwhelm the sick, not to relieve them, to give them blood through transfusion, since the greatest secret of medicine is to remove it by bleeding, the experience having shown that the abundance of blood is dependent on nature in almost all diseases. It is true that it is said that transfusion is always accompanied by bleeding, and that no blood is given that has been removed before; but the author replies that it is destroying what the bleeding has done; that it is not unloading nature, but only changing its burden; and that a sick person would not be more unloaded than a porter would be, unloaded from a sack of peas and be loaded with a sack of beans.

But assuming that transfusion was of some use, it would be necessary, in order to do so, to use the blood of man and not the blood of a beast; because women's milk is better for children's food than that of any other animal, it follows that the man's blood should be better than any other for transfusion. (*Journal des Savants,* 1668, p. 15.)

Tardy, in his letter to Le Breton, a doctor of medicine at the Faculty of Paris, admits that the blood of men is better for transfusion than that of animals; but he also admits that if transfusion is not good for all diseases, and especially for pleurisy and all hot diseases, in which it is more useful to remove blood than to give blood, nevertheless it should not be rejected, because it can be useful in many other cases.

In order for transfusion to triumph over all these more or less serious reasons, its supporters had to be able to bring new facts and new successes to their opponents. The example set by Denys could not remain sterile; it was imitated, and the English surgeons we saw already experimenting first on animals, in turn practiced transfusion on man.

Richard Lower and Ed. King took, in fact, six or seven ounces of blood from a man named Arthur Coga, and transfused him immediately afterwards with nine of ten ounces of blood from the carotid artery of a lamb; he felt so well with this operation that he begged, a few days later, that it would be done again. But Richard Lower and King thought it appropriate to delay for some time. (*Journal des Savants,* February 6, 1668, p. 17.)

Denys, emboldened by the two successes we have previously mentioned, found the opportunity to do the transfusion again on a man, and did not let it escape. This operation is too important, by the consequences which it brought about, not to make it known in some detail.

The patient in question was thirty-four years old. Since the age of twenty-six, he had given unequivocal signs of madness. This madness had presented marked intermittences. The patient had alternatives of restlessness and calm. Soon his agitation became extreme; he fell into a complete state of delirium. Being in the country, four leagues from Paris, despite all the precautions employed to prevent him from escaping, he managed to escape and arrived naked in the streets of the capital.

M. Montmor, touched with pity, entrusted him to Denys, who, together with the surgeon Emmeretz, gave him the transfusion. Emmeretz opened the crural artery of a calf, and having drawn ten ounces of blood from the vein of the right arm of the madman, he was transfused with five to six ounces of calf blood; at the same time, the patient felt a marked heat in his arm and under the armpit. The delirium having calmed down a little, Denys performed another transfusion on his left arm, which was more abundant than the first. Calm returned completely after several days; for knowing that at Christmas, he sent for his confessor to prepare for communion; he confessed so accurately that his confessor gave a public testimony of his good sense. His wife increasingly confirmed the good effects of the transfusion, telling Denys that, in the present day (it was a full moon), her husband used to be very upset and very angry with her; instead of being human and gentle with her, as he was now, he had been in the habit of swearing and hitting her.

Since then, this man became quiet, was able to go about his business, and spent his nights in uninterrupted sleep. (*Abstract of the Philosophical Transactions of the Royal Society of London*, Part 6, 1790, p. 387 et seq)

This man, who had been operated on towards the end of 1667, remained cured until January 1668; he relapsed at that time.

We borrow the following details from Dr. Chereau, which he himself copied verbatim from Denys' account:

"Mr. Emmeretz inserted a cannula into the veins of the sick arm; and as it is necessary to draw blood from the veins when one wishes to introduce it again, he opened the vein of the foot for this purpose. But a violent shaking having seized him in that same moment, with a tremor of all the limbs, no blood came out of the foot, or any from the arm. This forced Mr. Emmeretz to raise the cannula which he had put in the vein of the arm, without loosening the calf's artery, as it must be to communicate blood, and thus the transfusion was absolutely not done."

Be that as it may, Mr. Chereau continues, the enemies of transfusion, and there were many of them, threw themselves like vultures at the poor experimenters. The Faculty of Medicine of Paris, which was opposed to any progress, which did not yet recognize the Harvey's circulation, which had rejected antimony, quinquina, which was satisfied with Hippocratic physiology, which saw with anguish the science emerging outside its schools, and which believed itself to be the eternal repository of medical knowledge; the Faculty, we say, without directly interfering in this affair, caused several of its members act secretly, and published, under the veil of anonymity, pamphlets against Denys and Emmeretz. It was even accused of having bribed the widow of the unfortunate madman and having thus instructed her to accuse the transfusion for her husband's death.

The scandal took on colossal proportions; the Mauroy woman, driven far more by greed than by pain, sought to exploit the catastrophe by a kind of "blackmail," and things came to the point that Denys, who had hitherto let jealousy bite down, thought it his duty to apply to justice; because, as he himself says, "it was a question, not of his interest, but of that of the public, of making known these illustrious doctors who had the spirit so black and so low that to have fun with these intrigues unworthy of men of letters." Denys, assisted by M. François Mulot, filed on 9 April 1667 a complaint in the hands of Antoine Daubray, a criminal lieutenant at the Châtelet. Antoine Daubray immediately informs. Several witnesses come to testify against the widow and against all the doctors who had excited the widow Mauroy. André-Lefèvre d'Amenon, the king's lawyer, concluded that the case had been sentenced. She was called to the Châtelet on the 17th of April 1668, and Antoine Daubray pronounced the following sentence:

Sentence returned to the Châtelet by the criminal Lieutenant on April 17, 1668.

"In this case, the following facts have been proven:

1. The operation of transfusion was performed twice on Mauroy, insane, and was tried a third time. It succeeded so well the first two times that we saw this man enjoy, for three months, all his good sense and perfect health.
2. Since the first two operations, his wife gave him eggs and broth for food and slept with him four times. Despite the defence of those who treated him, and without telling them about it, she took her husband home, who only with great reluctance went there.
3. Since that time he frequented public houses, took tobacco, and having fallen ill again, his wife made him drink spirit liqueurs and broth to which she mixed certain powders.
   Mauroy complained that she wanted to poison him and that she gave him arsenic in his broths, she prevented the assistants from tasting it, and, feigning madness, she threw the contents of the mixture and the spoon on the ground.
4. Mauroy had frequent quarrels with his wife; she beat him even though he was ill; having given her a blow, she said that he would repent, though she had to die.
5. When the transfusion was tried for the third time, it was after very strong representations from his wife. Those who were to practice it would consent to do so only with the permission of the Solicitor General. On the very day that the operation began, barely a little blood had come out of the patient's foot or arm, a tube was placed in the vein; then the madman began to shout, although, it seems, the calf's blood had not yet passed through his veins, and the operation was not continued. The patient died in the night.
6. This woman did not want to allow anyone to open her husband's body, giving the reason that he was already in the coffin, when he was not there.
7. Long after the death of said Mauroy, three doctors offered money to the woman to make a complaint, accusing the transfusion of having killed her husband; she said, when these people had left her house, that she had agreed with them, and that if those who had done the operation refused to give her what was necessary for her to return to her country, she would do what she had concluded with the others."

A witness testified that she came to ask him to inform the operators that if they did not want to provide for all her needs throughout her life, she would accept the offer of the aforementioned doctors.

Another witness testified that a doctor offered him 12 louis d'or to claim that Mauroy had died during the actual transfusion operation.

There is sufficient reason to inform this matter fully and to examine this woman; to inform, in order to know what these powders were; why she gave them to her husband, who ordered them; why she prevented the opening of the body by her lies. New information will have to be taken, and in the meantime we will ensure the aforementioned woman.

As for the three doctors who had offered her money to persecute those who had performed the operation and who had been seen with her, they would be assigned one day to appear in person.

Finally, considering that the first two transfusion operations were successful, and that if a third was undertaken, it was at the urgent requests of the woman, who had moreover very badly observed the orders of the operators and who is suspected of having caused the death of her husband, it is requested that a day be assigned for her to appear in person in order to complete the case.

Thereupon it was decreed that the widow Mauroy would be subpoenaed to appear in person, and would be examined on the aforesaid information, and that

further information would be taken on the content of Mr. Denys' complaint, and that in the future transfusion could not be done in humans without the approval of a doctor of the Faculty of Paris.

From this sentence it is impossible to draw anything other than these conclusions:

1. That it is Jean Denys who is the "plaintiff and complaining"; in other words, it is Jean Denys who is the accuser, not the accused.
2. That as regards transfusion, as Denys himself writes, it is not absolutely forbidden by this sentence, since in order to do it freely, it would only have to have the approval of some doctors from Paris, and as of now we have seven or eight who have signed the proposal. (*Union. médic.*, p. 397, 1874.)

It is with this edict of Châtelet that the first period of the physiological history of blood transfusion ends.

SECOND PERIOD

During this second period, which extends from 1668 to 1818, the transfusion of blood fell almost completely into oblivion. I say almost completely, because a few authors are still dealing with it.

Thus, shortly after the edict of the Châtelet, Richard Lower spoke of it in his book on the heart (*Tractatus de corde*, p. 141, 1669.). The following year Manfredi was successful.

But the most terrible assault on transfusion, says Mr. Jullien (Jullien, *Loc. Cit.*, p. 30), was by Merklin in his book titled: *Tractatio medica curosa de ortu et occasu treansfusionis sanguinis* (Nuremberg, 1679).

Chapter 6 draws its arguments from the sacred books: “Positiones, sive argumenta aliquot ex sacris et profanis scriptoribus contra transfusionem afferuntur; quæ Romæ et Lutetiis (Paris) interdicta est; et ab aliis etiam et viris improbatur. Duplici gravissimæ occurritur objectionis. » — « ... Ipse sapientissimus Deus, cujus consilia inscrutabilia sunt, non uno sacrarum litterarum loco, Mystis suis præconibus, belluini sanguinis usum sub indignationis pæna humano generi prohibuit, ut videre est. Hæc inter dictio etsi nobis sin ulla addita ratione sufficientis sima, et tanta omnino esse possit, ut ne latum quidem unguem, ab ea discedere nobis liceat.”

Besides, what is the use of transfusion? Can it provide services? No. "Non facit contra lepram, non contra luem veneream, non contra cancrum, erysipelas aliaque ulcera externa; non contra variola; non contra plenitidem, aliasque internas inflammationnes; non contra hæmorrhagias; non contra rabiem, nec denique contra ullum alium morbum.” (caput III).

The ninth and last chapter, however, contains some reservations about human-to-man transfusion: "Transfusio sanguinis ex homine in hominem duplici modo fieri potest, nec approbatur, nec improbatur, sed in medio reliquitur et ad experientia examen relegatur.”

This condemnation, in the name of the Church, is, it should not be forgotten, the work of an individual, Merklin. Some authors have argued that the Court of Rome had railed against the transfusion. We went through the *Bullarium* with the greatest care, without being able to find the slightest allusion which, near or far, would have had any relation to our subject.

From 1679, we can mention only a few isolated facts: in Dantzick, doctor Schmidt again tried transfusion. He injected drugs into the veins of people with syphilis, gout, apoplexy, and apparently managed to cure many of them.

In Frankfurt-on-the-Oder, surgeons Balthazar, Kaufmann, and Mathieu-Godefroi Purmann healed a leper in 1683 by passing a lamb's blood through his veins.

Ettenmuller, of Leipzig, in 1682, recommended transfusion against fevers, hypochondria and scurvy. A small amount of blood must be injected several times.

In 1714, Nuck, in his book: *Operationes et experimenta chirurgica*, gave the history of this operation. He is of the opinion that it has been too much forgotten for fifty years; he says that it should not be proscribed; that it can provide great resources in wounds followed by considerable haemorrhages; it rejects the blood of animals in human transfusion.

M. de Lachapelle, in 1749, in his book: *Méthode naturelle de guérir les maladies,* was the first to try to bring minds back to the study of transfusion. But his efforts were fruitless.

In the same year, Cantwell, Doctor Regent of the Faculty of Medicine in Paris, is of the opinion that blood transfusion has previously yielded some success, that it is illogical to proscribe it in desperate cases (*Mercure de France*, June 1719.)

In 1783, Michel Rosa, professor and president of the Faculty of Medicine of Modena, through the experiments he made, shed some light on transfusion. He proved, among other things: (1) that the vessels of a living and healthy animal can admit a greater amount of blood than they contain, without being filled; (2) that the blood of one species can be mixed with another species without injuring life; (3) that the revivification of a bloodless and consequently inanimate animal, can be obtained by the introduction of the arterial blood of an animal of another species (*Lettere fisiologiche,* Napoli, 1783.)

We will see later that this opinion of Michel Rosa is opposed by the German School, represented by Bischoff and Dieffenbach.

Four years later (1792), Haarwood, at Cambridge College, revived a bloodless dog before his audience.

In the same year, a blood transfusion was given at Eye, in Suffolk, by Russell, who, seeing the impotence of the means employed to cure rabies, of which twenty people had died in one place, resolved to deviate from ordinary methods to cure a young boy with hydrophobia. He opened his veins and let out so much blood from him that he fell unconscious. Then, opening another vein, he introduced little by little, by direct transfusion, the blood of two lambs. The patient soon recovered and regained his health and strength.

Thus, Russell would have cured a man suffering *from rabies,* which he would have previously rendered bloodless, by transfusing him with the blood of two lambs.

The students who followed my physiology lessons at the Bordeaux School of Medicine have often heard me repeat: *that one can only hope to cure rabies by transfusion*. I am sure that I ignored Russell's observation when I formulated that opinion. If I have not yet been permitted to verify it, it is because the eagerly awaited opportunity has not yet presented itself. Besides, I will come back to this when I discuss the indications of blood transfusion.

Darwin, in 1796, advocated transfusion by using the blood of man, sheep or donkey, in putrid fever, in the squirrhe [hard tumour] of the oesophagus, or in obstacles to nutrition. He also says that blood should not come into contact with air and must retain its normal temperature. For this purpose, he made a special instrument.

Here ends the second period of the history of transfusion.

"During this period, the experiences were confused and indeterminate; despite their empirical aim, the bad conditions in which they were done and their results misinterpreted, it must be recognised that certain laws have been established that have remained true and that real advancement of science has taken place."

THIRD PERIOD

The third period of blood transfusion begins with Blundell in 1818. Let us say, however, that as early as 1815 several authors, almost at the same time, wrote about it: Hufeland, in his book: *De usu transfusionis præcipue in asphywia*, published in Berlin; of Graefe, in a book titled: *De novo infusionis methodo,* et de Boer, dans sa *Dissertatio physiologicamedica de transfusione sanguinis.*

An eminent Italian physiologist, Malachia de Cristoforis, has insisted that Michel Rosa resurrected the subject of transfusion, a priority which we had assigned to Blundell.

"After reporting," he says, "a period of one hundred and fifty years, during which transfusion fell into oblivion, the writers (Oré, Marmonnier, Scalzi, etc.) all start the third period with Blundell. My goal, on the contrary, is to do justice to experimental physicians who, before Blundell, dealt with the question. Blundell was preceded in his thirty-five-year experiences in Italy, by Michel Rosa, of Modena, who looked into it from 1783 to 1785."

"The proof of my assertions exists in the chronological dates. Indeed, Michel Rosa cites, in his *Lettres sur quelques curiosités physiologiques* (t. I), the numerous transfusion experiments on animals, and on page 288 of the same volume, summarizes them into three fundamental conclusions worthy of note; while it was only in 1818 that Blundell published his experiments on the animals by which he made so much noise. It is therefore incontestably proven that the transfusion was brought out of oblivion in Italy thanks to Michel Rosa." (Malachia de Cristoforis*, la Transfusione del sangue*. Milano, p. 42, 1875.)

I had, in fact, forgotten to mention Michel Rosa's research in my first edition; I am now repairing this omission. By placing the facts reported by the Italian doctor in the second period, I keep the priority claimed by Cristoforis. I would point out, however, that while this priority over Blundell is indisputable, it is also indisputable that one hundred years before Michel Rosa (1685), Purmann had cured a leper by transfusing him with lamb's blood; that in 1714 Nuck advised transfusion in wounds followed by severe haemorrhage; that in 1749 de Lachapelle and Cantwell sought to bring minds back to the practice of this operation. Also, while giving Michel Rosa priority over the English physiologist, we are forced to acknowledge that he had been preceded by others, even in this second period, a period of *oblivion,* as follows from what precedes.

But apart from these few facts, which occur only at rare intervals, the transfusion of blood was almost been forgotten for a century and when an unfortunate circumstance came to the pass, it was for having witnessed it, that Blundell took on the animals of the experimental research which he soon applied to man.

"A few months ago," says Blundell, "I was with a woman who was dying as a result of uterine haemorrhage; the losses had happened before my arrival, but the fate of this patient was decided. Despite the best efforts of the doctors, she died after two hours. Later, reflecting on this sad scene, for there were circumstances which gave it a particular interest, I could not help thinking that the patient could probably have been saved by transfusion, and what would have been little expedient to operate on in the usual manner, the vessels could have been filled with ease with and speed by means of the syringe." (*Medico Surgical Transactions,* Vol. IX, p. 56, 1818)

However, fearing that the blood would no longer be ready for animal functions after passing through a syringe, Blundell sought to verify this experimentally.

First experiment:
With the femoral vein exposed in a dog, the surgeon inserted a tube into the artery, with the help of which he drew eight ounces of blood from the animal in two minutes.

The most alarming symptoms soon showed themselves: difficulty in breathing, deep convulsions, profound fainting marked by the cessation of circulation, the loss of sensitivity by a complete relaxation of the abdominal muscles.

After a few seconds, six ounces of blood were taken from the femoral artery of another dog and injected into the vein. The animal revived, breathing became regular again, and sensitivity was restored. This resurrection was so complete that the animal seemed to wake up, rather than emerge from an apparent state of death. (P. 57 and 58.)

Blundell concludes from this experiment *that the passage of blood through the syringe does not make it unsuitable for animal functions*.

Second experiment:
The femoral vein of a dog was exposed; a pipe was inserted there as well as into an artery. As the blood escaping from the artery fell into a vessel, it was immediately introduced into the vein. This operation was continued for twenty-four minutes, and the dog did not appear inconvenienced. (P. 59.)

Blundell concludes from these experiments that transfusion of blood into the veins of a human creature, by means of the syringe, can produce the most beneficial results.

The experiments I have just mentioned are not the only ones that have been done by the English surgeon; in fact, he reports others in which he sought to establish what would happen if the blood was allowed to remain for a period of time in the vessel intended to receive it, before injecting it into the veins of an animal, and moreover by borrowing blood from an animal of another species.

Thus, human blood having remained for *sixty seconds* in a vessel was introduced into the veins of several dogs; *they all died* either immediately after the operation, either sometime afterwards or after several days.

These experiments, already attempted by Mr. Goodrige of Barbados, and by Dr. Leacock, had given them the same results.

Blundell, fearing that the introduction of the blood with a syringe would allow air to enter the vessels and fearing the presence of this gas, investigated whether it could not be borne at a low dose without compromising life. For this he attempted a few experiments, from which he concluded that air, *if it is not in too great a quantity in the veins*, can be endured without disturbing the functions of the animal in a sensitive way.

We will have an opportunity to talk about these results and to add to these facts those that our own experiments have allowed us to see.

All the experiments reported so far have been done with arterial blood; it was important to see if venous blood would give the same results. Blundell's research taught him that venous blood from humans, introduced into animals, does not bring life back any better than arterial blood.

After recounting his experiences, Blundell describes the device he invented for perform transfusion. This will be discussed in another part of these studies.

The English Surgeon's Memoir ends with an account of experiments that can be divided into three series:

FIRST SERIES: *Arterial blood was transfused into dogs that had suffered severe haemorrhage and appeared to be in a state close to death*. The movements of the heart soon recovered, and the animal came back to life. Blundell points out that to achieve this result, it always took a much less blood than the animal had lost.

SECOND SERIES: *Transfusion of arterial blood from an animal into the veins of the same animal*. The result was almost instantaneous: the animal came back to life.

THIRD SERIES: *Transfusion of human blood into a dog's veins*. – Blundell had done many experiments to observe the influence of human blood on dogs.

First experience:
A small dog, in full health, 113^{gr}40 of blood was withdrawn through the femoral artery; he was taken with dyspnoea, convulsive movements; the circulation stopped, asphyxiation became complete. 113^{gr}40 *human* blood was injected in parts into his femoral vein; the dog seemed to revive, breathing and circulation recovered, but after a few minutes the animal succumbed.

Second experiment:
We took 311^{gr}85 of blood from an old basset dog. Immediately dyspnoea, the cessation of circulation, convulsive movements were observed; the animal was about to succumb, it was injected with 283^{gr}5 of human blood, divided into five parts. Although very weak, the animal could walk, but died twelve hours after the operation.

Third experiment:
Blood was taken from a bitch for as long as the ordinary phenomena of haemorrhage, such as sighs, convulsions, absence of circulation, did not appear; she thus lost 198 grams of blood. 170 grams of human blood were injecting into her veins; breathing recovered a little and the abdominal muscles contracted, but the heart made only weak and irregular movements. Finally, the dog was seized again by convulsions; she made some effort to vomit and a few minutes later she succumbed.

Blundell multiplied these experiments, and he came to the conclusion, that if, immediately after transfusion with human blood, *the dogs appeared to revive*, the awakening was very short lived, for the animals *all* succumbed in a few hours after the operation.

Blundell's experiments, in somehow resurrecting the transfusion of blood, were not to be without influence. As we have seen during the first period, from 1665 to 1668, surgeons from all countries dealt seriously with this issue, so the example given by the English surgeon had to be followed; it was indeed, and numerous works then appeared. In France, we see Mr. Milnes Edwards, the learned dean of the Faculty of Sciences of Paris, in his inaugural thesis for the doctorate in medicine submitted in 1823, formulated this proposition: "In severe haemorrhages, one can have recourse to blood transfusion."

Two years later, Mr. Prévost and Mr. Dumas concluded their research on blood cells with a few experiments on: *this operation, unfortunately too famous, and which has been so abused in an arrogant and barbaric century*.

"If you take the blood that you inject into an animal of a different species, but whose blood cells are of the same shape, albeit of different dimensions," say Mr. Prévost and Mr. Dumas, "the animal is only imperfectly raised, and it can rarely be kept for more than six days."

The animals subjected to these tests present some phenomena that we must not omit: the pulse becomes faster, the respiration keeps its normal state, but the heat is lowered with remarkable speed when it is not artificially maintained as soon as possible from the moment of the operation; faeces become mucous and bloody, and retain this character until death; the instinctive faculties are not impaired. These observations apply to the injection of fresh blood, as well as that of blood extracted for twelve and even twenty-four hours; it is enough to prevent clotting by ordinary agitation, and to separate the fibrin isolated from it by means of a cloth.

If we inject blood with circular cells into a bird, the animal *usually dies* in the midst of very violent nervous accidents, comparable in their rapidity to those obtained *by*

means of the most intense poisons. They are still manifested, when the subject on which one operates has not been weakened by a significant loss of this liquid.

Cow and sheep blood was transfused into cats and rabbits. Either the operation was performed immediately after the blood was drawn, or the blood was left in a cool place for twelve hours and even twenty-four hours, the animal was restored for a few days in a large number of cases.

Sheep's blood transfused to ducks excites rapid and very strong convulsions, followed by death. Often we saw the animal die before we have finished pushing the first syringe, although it had only experienced a very weak bloodletting before and was very well.

"We will confine ourselves", say Mr. Prévost and Mr. Dumas, "to those few words on the question that Mr. Blundell has recently successfully attempted, but from a point of view different point ours; and if it has been mentioned here, it is in order to prove that transfusion on man *must be abandoned as absurd and dangerous* until we are further advanced on the full knowledge of the active principle of blood." (*Bibliothèque universelle de Genève*, p. 226, t. XVII, 6the year, 1821.)

The preceding quotation sufficiently proves that Mr. Prévost and Mr. Dumas were not, in 1821, supporters of blood transfusion. Is it the same today?

One of the most important memoirs on transfusion is the one that Dieffenbach published in the Muller Archives, an excerpt of which can be found in the *Archives de Médecine*. (fre série, t. XXII, p. 99, 1810.)

The author points out that transfusion can be done in two ways:

1. *Immediate* transfusion using an intermediate tube from one animal's artery to the other's vein.
2. *Mediate* transfusion, which is carried out by pushing into a vein, by means of a syringe or any other similar device, blood drawn from the vessels of an animal more or less long after its exit.

1. Effects of immediate transfusion on animals exhausted by a severe haemorrhage

Dieffenbach has had numerous experiments with immediate transfusion; he reports eleven of them in his memoir. I will borrow only one, all the others being similar for the procedure followed and the results obtained.

He opened the carotid artery of a small dog and let the blood flow until the animal gave no signs of life. This apparent state of death was preceded by violent convulsions. During nervous accidents, the pupil dilated and contracted alternately, until it remained completely still and widely dilated. The jugular vein was then opened.

Dieffenbach exposed the carotid artery of another dog, inserted the tube into both the artery of one and the jugular of the other; he let the blood flow into the vessels of the second. The dog who received the blood appeared to breathe better at first, but still did not survive.

This experiment was performed on six dogs, two cats, an old sheep, a calf and a kid; it was followed by the same results in three dogs, the young cat and the kid. All these animals perished more or less promptly. The three other dogs, the old cat, the sheep and the calf, recovered little by little and recovered their health after a variable time, from a few hours to three days.

Immediate transfusion can therefore sometimes save life. Dieffenbach adds, however, that even in successful cases, it is not without danger.

2. Effects of mediated transfusion performed with a syringe on animals exhausted by a strong haemorrhage

All these *mediate* transfusion experiments were done with blood freshly drawn from the vessels, and which still retained its heat. Two-thirds of the animals have been brought back to life.

Dieffenbach, continuing his research, verified *how long the blood drawn from the vessels retained its property to revive an animal.* He concludes from his experiments that after three hours he loses its effect.

The coagulated and re-dissolved blood only rarely showed any signs of life; there was never a complete revitalization.

3. Effects of transfusion of blood from an animal on other animals of different species

"I have never been perfectly successful", says Dieffenbach, "in reviving an animal with the blood of animals of different species. Dogs were, however, sometimes roused from their apparent state of death by the mediated transfusion of sheep or human blood, but most of them perished quickly, amid violent convulsions, especially when I used human blood. None of these animals survived the sixth day. Other experimenters, however, seem to have been more successful than me. Mr. Blundell, among others, claims that he brought a dog to life by transfusing it blood from a man, and that the animal survived the experience perfectly. As for me, despite all conceivable precautions, I have consistently failed."