ETUDES HISTORIQUES ET PHYSIOLOGIQUES SUR LA TRANSFUSION DU SANG

By: Dr PIERRE CYPRIEN ORÉ (1868)

A TRANSLATION OF PAGES 2 - 112 BY PHIL LEAROYD

A copy of 'Historical and physiological studies on blood transfusion' by Pierre Cyprien Oré, originally published in 1868 in Paris [by J-B Baillier & Sons] can be viewed or downloaded from the following sites:

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I have translated the two 'historical sections' of this important 189-page 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 made this translation to be as 'un-interpreted' as possible, 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 saying'. I wanted to avoid that as much as possible and try to present what the author actually wrote and as such 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 the people identified by the author, the spelling is his own, or changed the wording of the references, which he places within the text itself. I have however in a small number of places included words or short texts in square brackets to explain a particular word or term used by the author.

The book or 'Memoir' is presented in three parts – I have translated the first two, i.e. 'Physiological History of Blood Transfusion' and the 'Pathological History of Blood Transfusion', but not the third part, which includes the author's experiments into various aspects of transfusion. The 'Physiological History' is presented as three time periods, i.e. 1665 – 1668, 1668 – 1818 and 1818 – 1868. Prior to this Oré includes summary information regarding ancient texts published prior to 1666, though like many authors he believes many of these to be allegorical.

Within the first time period of 1665 – 1668, as would be expected, the 'priority disputes' between England, France and Germany are clearly presented with the author concluding that Lower performed the first animal-animal transfusion (i.e. "the

first to make known a complete procedure for carrying out the transfusion") and Denys the first animal-human transfusion (he concludes like many since that Major's claims, that he performed transfusion, cannot be substantiated) and also includes details of the experiments performed by Cassini and Griffoni in Italy in 1667. He describes Lower's technique in some detail as well as Denys' reasons for performing transfusions on humans. These include 'feeding' (he compares this with the mother's blood feeding the fetus), and includes the fact that since the patient is bled prior to the transfusion it removes some of the patient's 'corrupted' blood and that transfusion does not diminish the patient's strength, and therefore the technique should appeal to those who approve as well as disapprove of bleeding! He also uses the argument that by using arterial animal blood rather than human blood as the donor, the technique does not diminish the life of one person, the donor, to improve that of another, the patient. He then adds, as is the belief of his time that animal blood is 'less corrupt' anyway. Oré only briefly and rather dismissively includes the arguments presented by Martinière and Lamy, the main opponents of transfusion at the time, as being based only on feelings and not science or medicine, but does provide information regarding the more balanced comments made by their colleague Gadroy. The comments made by all protagonists in the arguments does however illustrate their lack of understanding, at the time, of 'what blood is' and especially 'what blood does'.

The author then describes Denys' first two human transfusions on a 16-year-old boy and a 45-year-old sedan-chair carrier using lamb's blood in some detail, which of course the author explains as being "too important because of their consequences" – he then provides interesting details of the sentence given to Châtelet by the lieutenant of criminal cases (Paris, 17th April 1668) regarding the death of Mouroy. As a result of these findings, which had implications throughout Europe, the second historical time period of 1668 – 1818 identified by Oré is understandable only a paragraph long!

The third period includes a lot of information regarding Blundell but also includes his reasons for believing transfusion to be necessary – an interesting comparison with those of Denys 150 years earlier. The author also summarises Blundell's animal experiments as well as descriptions of his transfusions on humans, the former being normally overlooked by many authors presenting information on the 'history of transfusion'. Oré also however provides analysis of the results and summaries conclusions made by other researchers of the time, especially Dieffenbach and Bischoff, which illustrate the underlying problems associated with the ability to defibrinate blood correctly as well as the practical problems associated with what are termed 'immediate' (indirect using defibrinated blood') and 'mediate' (using untreated donor blood) transfusion methods.

The 'Pathological History of Blood Transfusion' section (Part 2) collects together as many of the published reports of transfusion between 1665 and 1868 as the author can find. He presents details of these cases, which he does not alter, but does occasionally comment on – the reader is left to agree or disagree. I have included this extensive section within this translation because, although the conditions / reasons for performing the transfusions are no longer valid, it provides, to my knowledge, a unique collection that describes all the published cases, though the descriptions of some cases are far more detailed than others and many lack details of the actual transfusion techniques used. The transfusion cases are broken down into eight categories and as one would suspect, those of metrorrhagia (45 cases), traumatic haemorrhage (10 cases) and anaemia due to various causes (8 cases) predominate. Whilst one would, with modern knowledge, find the use of transfusion in other categories (e.g. madness and dysentery) indefensible, these cases are all of historical interest.

Oré states “that many questions still exist that require answers” as a summary to his history section and a means of linking it to his own research work presented in the third part of his book.

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 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 he 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)

‘Transfusion du Sang’ (1868)
(image credit: archive.org)

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 by many 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 great things; to be convinced of it, it suffices to take a look at the writings of time. We read, in fact, in the *Dictionnaire des Sciences de Neufchâtel*, Vol. XXVI, p. 517: "We fought at first for 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 this 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 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 the cannibals, Jerusalem artichokes, the 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, Denis, at the head of the transfusers, called those who thought otherwise *jealous, envious, wretched*, and called La Martinière a miserable tooth-puller and operator on 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 up 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.

Nearly two centuries have passed since the Châtelet's sentence. In turn abandoned and revived, blood transfusion did not make a fortune, and the severe judgment brought against it in 1668 would still be accepted today; and yet important facts published in scientific and medical collections have multiplied! Carefully studied, but above all with a clear spirit of prevention, subjected to rigorous criticism, these facts should, it seems, have brought this operation back into honour, and thus provided therapy with a powerful weapon in desperate cases; this has not been the case, and nowadays transfusion has little support in the medical world. Without multiplying the quotations, it will suffice, to prove it, to recall the opinions expressed in their writings, by the men who rightly occupy a considerable surgical position.

In their *Traités de Médecine Opératoire,* Messrs. Velpeau and Sédillot make no mention of blood transfusion.

Mr. Chassaignac, in his book titled: *Traité clinique et pratique des opérations chirurgicales*, states: "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, p. 408. Paris, 1861)

Mr. Alphonse Guérin is even more opposed: "*Until now*," he said, "*transfusion must be regarded as an operation much more dangerous than useful."* (*Éléments de Chir. opératoire*, Paris, 1858, p. 83, 2nd edition)

Professor Malgaigne devotes a page of his *Traité de Medécine Opératoire* to blood transfusion; but he merely indicates, without judging it, the process generally adopted to practice it.

Transfusion has therefore not yet acquired a right of citizenship in science, as the opinion *that it offers no chance of success* is generally adopted, even by the highest minds. To find out whether this opinion is correct, if it is based on a thorough examination of the known facts, is the task I have imposed on myself in this first Memoir. For this, I have gathered all the scattered elements in the authors; I will report them without altering them, either in substance or in form, in order to enable those who read me to judge the value of the conclusions I must make.

I will divide this first Memoir into three parts:

- In the first, I will give the physiological history of transfusion.
- In the second, you will find all the transfusion operations performed on women and men.
- Finally, in the third, I will share the results of my experiments on the introduction of air into the veins, and thus resolve the first objection which may be made to the transfusion of blood.

PART ONE
PHYSIOLOGICAL HISTORY OF BLOOD TRANSFUSION

The physiological history of blood transfusion can be divided into three periods: the first extends from the year 1665 to 1668; the second, from 1668 to 1818; the third, from 1818 to the present day. A preliminary question arises. Was it in the year 1666 that the idea of blood transfusion appeared for the first time?

FIRST PERIOD

Without going into great detail on this point, it is easy to establish that the possibility of transfusion had been accepted by the ancients. We find the proof:

1. In *The History of the Ancient Egyptians* where we see that these people practiced it for healing their princes.
2. In the *Book of Wisdom* of Tanaquila, wife of Tarquin the Elder, where it is said that she used transfusion.
3. *The Treatise of Anatomy* by *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 of the Eubages.*
7. The *Works of Pliny and Celsus* and several others, who condemn it.
8. *Ovid's Metamorphoses*. Medea, pretending to yield to the daughters of Pellias, who asked her to restore their father's youth and vigour, expresses herself thus:

Stringite, a gladios; veteremque haurite cruorem,
Ut repleam vacuas juvenili sanguine venas!
(*Metamorphoses*, liv. VII.)

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, Marcil Ficin, Father Trithème, Aquapendente, Harvée and Fra Paola, had experienced it themselves.
(All these indications can be found in a letter from La Martinière to M. de Colbert.)

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 trabens; magister artis habeat tubulos inter se congruentes, aperiat arteriam robusti, et tubulum inserat, muniat; mox et ægroti arteriam findat et tubulum foemineum infigat. Jam duos tubulos sibi mutuo applicet, et ex sano sanguis arterialis, calens et spirituosus salicet in ægrotum, unaque vitæ fontem afferet, omnem que Languorem Pellet." (Libavius, *Appendix necessaria syntagmatis ascanorum chymicorum*, ch. IV, 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 we must think about 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," he said, "ille robustus non-languagescet; danda ei sont bona confortantia, et ubique medico vero helleborum." (*Journal des Savants*, Monday, July 2, 1668, p. 37)

All these quotations prove that the ancients had glimpsed the possibility of transfusion; perhaps even this operation had been performed, but apart from the text of Libavius, which seems to indicate a process for doing it, there are only vague, uncertain, usually null indications in the authors who preceded it. It was only in the year 1666 that we find the first serious description of the method used by surgeons to perform this operation.

The transfusion had therefore been foreseen by the ancients; but it was not until the beginning of the second half of the 17th century that it began to rank among the regular operations of surgery.

What I have already said about the quarrels to which it gave rise will explain the claims of the English, French and Germans to 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 the experiments of Richard Lower which were made in 1666, *the first idea of transfusion was born*.

Thus, says Denys, in a letter to Mr. 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, and there are still several copies of it; it is true that most of them scoffed for this proposal, and that it was believed to be impossible. The English, seeing that no state of this invention was made in France, sought to seize it as something abandoned, and practiced it on the beasts; but we have finally claimed it, and we have found a way to regain possession of what belongs to us, by practising it first on man. (*Journal des Savants,* Monday, June 28, 1667, p. 96)

An answer to the above can be found in a passage borrowed from *the History of the Philosophical Transactions*, where it is said:

"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 also need to learn the truth, which is that philosophers in England, would have long since made this experiment on men, if they were not so circumspect when it is a question of putting to chance the life of the man, for the preservation and recovery of which they however spare no care or punishment, and if they had not been restrained for fear of a law that is more precise and more rigorous, in similar cases, than the laws of many 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 draw 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 the blood of a healthy person could penetrate, without mixing, with the blood 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 and 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 [presumably meaning the *Philosophical Transactions of the Royal Society*] containing how to pass blood from one animal to another. 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 in it, and tie the artery tight with the two threads over this pipe, which you will plug with a small cap. After that, uncover the jugular vein of the other animal at the length of 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. These two pipes being put in this way and being well connected, keep them closed with a stopper until it is time to open them."

"With everything thus prepared, tie the dogs to each other on the side, so that other pipes can be passed through the first two; because, as we cannot approach the necks of the dogs close enough to each other, we have to 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 the 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 while 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 the other jugular vein with your fingers), 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 eventually dies on that side."

"Then pull the two pipes from the dog's jugular vein, and having fully tightened the slipknot, cut the vein at the top (which can be done without any harm to the dog, because one of its 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 who 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, a professor of philosophy and mathematics, wrote a letter to M***, in which he recounts some experiments which he made on animals.

"On Thursday, March 3," he said, "they brought to us, Mr. Emmeretz, our surgeon, and me, two small dogs that had never been fed together, and which, in their faces, seemed as different as some animals of different species, one being a 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 was only ten inches tall."

"We proposed to do, not only what was marked in (Richard) Lower's letter, *which is to pass the blood of one animal into another by killing the one who communicates it to keep 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 that carries it by the neck into the brain; besides that 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 prone to clogging up when the blood passes though it, and the bitch does not suffer so much, it would be easier to make her escape."

"Indeed, it happened in the presence of several worthy persons, as we had foreseen, and in a fairly simple and easy manner."

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 from this third pipe into a dish," continues Denys (which is a lot for an animal of this size), "the bitch who had given him as much, and therefore had little remaining, 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 the two slipknots we had made there, we untied 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 a 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, which 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 for 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, had been supplied by the second, amounted to this quantity. The two dogs escaped perfectly, and after some considerations on the conditions that must be achieved by performing the transfusion, Denys finishes his letter:

"All this took place with great astonishment of 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, p. 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 it was intended to be killed, the vein was opened soon after, and the blood was allowed to flow as long as it could flow. Sixty-five ounces were taken out 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, he no sooner felt itself at liberty, seeing near him a spaniel which had previously been transfused with sheep's blood, he went and give 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 without 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 judged that a lamb of such a size could supply him with, from which blood would be allowed to flow until he died. Then two ligatures were made close enough 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 to 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 of 1668, he died suddenly, 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 a few fibres, and that the upper part of this vein had communicated with the lower by means of a small branch that could somehow 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 for its species, aged thirteen years old, and quite deaf for more than three years, so that, whatever noise was made, it gave no sign of hearing it; he walked very little, and he was so weak that unable to lift his feet, he only 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 more greedily than before. But what is more surprising is that from then on he gave indications that he was beginning to hear, turning back a few times to the voice 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 nonetheless that when he was called, he would turn 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)

Since experience has shown that transfusion is not only possible, but easy, it now remains to be seen whether it is advisable to perform it on humans and whether some considerable advantage can be gained 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 would often lead to the opening of the arteries, he believes that instead of transfusion 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 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 assumes that the person who provides the blood gives only that which is superfluous to him, because otherwise this operation would be barbaric.

For the uses that can be derived from it, he thinks that 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 the curing of diseases that come from acrimony of the blood, such as ulcers, erysipelas [a form of cellulitis], etc. The medicines that one takes, says Tardy, hardly cure these kinds of diseases, because they often lose their strength before they can come to the seat of the evil; but a new blood, well tempered, going directly into the diseased parts by means of transfusion, should give a much faster and more assured relief. Moreover, this author remarks that the blood of a man is not absolutely necessary for this operation and that of a calf or another 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; that, thanks to it, a scabby dog has been cured; that a deaf dog recovered its hearing.

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 boundaries. The reasoning, together with the facts, hinted at 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 to French surgeons that all the glory goes.

We find in a letter written by Denys to M. de Montmor, master of the requests, the account of two transfusion experiments carried out 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 simply imitating the example of nature, which, in order to nourish the fetus in the mother's womb, the mother's blood is continuously transfused into the child's body through the umbilical vein. To be given a transfusion is nothing more than feeding oneself by a shorter path than usual, that is to say to put 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 mouth, having to pass through several parts that are often ill-disposed, can contract several bad qualities before having arrived in the veins; it is subject to several alterations, which are immediately avoided by putting perfect blood in these veins; in addition, this operation agrees with 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 the place of the one being drawn, the patient’s strength is not diminished, and finally reason seems to teach that diseases caused by bad weather and the corruption of blood must be cured by the transfusion of pure and well-tempered blood.”

After responding to those who condemn 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 well, the animal that provides the blood must be of the same species as the one receiving it, and thus can only prolong the life of one by shortening that of the other. But Denys shows 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 unclean than animals, which are less prone to these disturbances, and that indeed there is little corrupt blood in the veins of beasts, instead one always notices some corruption in the blood of men, no matter how healthy they are supposed to be, and even in the blood of small children, because they were fed their mother's blood and milk, they sucked up corruption with food. Moreover, Denys

adds, why should the blood of animals not be peculiar to men, since it is of the same species as the milk and flesh on which they usually feed? It could be added that if 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 the flesh of animals 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 lamb's arterial 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, became fat, and kept getting better and better until he was fully recovered.

As this first experiment was fortunately successful, Denys attempted a second; but more out of curiosity than out of necessity, for the individual on whom it was made had no indisposition: he was a strong and robust [sedan] chair-bearer, about forty-five years old, who, for a relatively modest fee, offered to endure this operation. As he was well and had a lot of blood, he was given a much larger transfusion than the first; for 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, other than that he felt a great heat from the opening of the vein to 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 spent 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 they would take no one else other than himself when they wanted to repeat the same operation again. (*Loco. cit*., p. 95)

The consistently successful results observed in animals, and the two successes obtained in man 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-transfusionists energetically attack the 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 the transfusion.

He claims that this operation is rather a new way to torment the sick than of curing them, because the diseases which it is said to be useful as a remedy are precisely those that come *from excessive heat of blood, or from its corruption.*

In those caused by too much heat, transfusion cannot take place; for the blood which is temperate, being warmer than the patient's own blood, will increase the heat of the patient's blood far from diminishing it; it will be no more useful in the diseases that arise from the corruption of the blood, because the little foreign blood that one receives through this operation will much rather be corrupted by all the mass of blood that is in the body of the patient, than the bad weathering of the whole mass of blood will not be corrected by this little foreign blood; because 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 will 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 causing disease; for, as the blood of a calf or animal of any kind is composed of several different particles intended to nourish the different parts of his body, he asks if this blood is passed through the veins of a man, what will become, for example, 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 replied to the arguments presented by Lamy in a letter to Father Bourdelot:

He first contrasts 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 languishing in old age, after receiving the blood of a kid, not only was well, but was, so to speak, 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 refresh; just as veal broth does not fail to refresh, although it feels warm when it is swallowed.
2. That, as to the observation that a little good foreign blood put with a large amount of corrupted blood, cannot correct the bad weather, does not prove that the transfusion is useless, because one can do as large a blood evacuation as one will want, before transfusing it again, and that therefore, nothing will prevent us from putting a large amount of good foreign blood with a small amount of corrupted blood that will remain in the veins.
3. Let us not be afraid that the horns may come from 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. He had already been three months since he had taking any food, he had lost consciousness and speech, and the doctors who treated him had abandoned him; however, after the first transfusion of about two pallets of blood, his pulse immediately rose, his belly flow stopped, and his speech came back as well as knowledge. They were already beginning to conceive of some hope for his health; but after having been twenty-four hours in this state, he relapsed into the same symptoms as before. A second transfusion gave him new vigour; nevertheless, it was not long, for he died about twelve hours later, and it was recognized, by the opening which was made of his body, that he could not live any longer, his intestines having all been found 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 contrary opinions we have spoken of so far. According to him, this operation is not as safe or of as great a use as some claim; but that it is not entirely useless either, much less pernicious, as others assert. It is a dubious remedy, which can produce good effects if it is properly administered, and which can have very unfortunate consequences if it is not used with great caution.

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 book 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 scoffs that, in order to authorize 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 would be on a third floor, wanting to come down, would not bother to go down the stairs, but to take the shortest path would jump out the window; for nature having shown no other way to drive blood through the veins than to pass it through the ventricle, there is temerity to take other ways.

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 bloodletting, 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 we do not give blood that has been removed before; but the author replies that it is destroying what the bloodletting 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 bag of peas and loaded with a bag of beans.

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

Tardy, in his letter to Le Breton, 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 given by Denys could not remain sterile; it was imitated, and the English surgeons whom we have already seen experimenting first on animals, in turn practiced transfusion on humans.

Richard Lower and Ed. King took in fact six or seven ounces of blood from a man named Arthur Coga, and immediately afterwards transfused him with nine or ten ounces from the carotid artery of a lamb; he felt so well from this operation that he begged earnestly, only days later, that it 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 on a man again, 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 intermittency. The patient had alternative periods of agitation 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 used to prevent him from escaping, he managed to escape and arrived naked in the streets of the capital. Mr. Montmor, overcome with pity, entrusted him to Denys, who, together with 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 five to six ounces of calf blood; at the same time, the patient felt a

pronounced heat in his arm and under his 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 it was Christmas, he brought his confessor to prepare himself for communion; he confessed with such precision 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 at the 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 an 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.

His wife, having given him remedies that had had no effect, begged Denys to do the transfusion again; he refused at first; then, yielding to the urgent requests that were addressed to him, he began the operation; but soon the patient was seized by a general tremor. The *transfusion was not done,* and death happened during the night. Suspecting that he had been poisoned by his wife, Denys asked for the corpse to be opened, and could not obtain it. The wife assured him that offers of money had been made to her to maintain that her husband had died as a result of the transfusion; she asked Denys to argue otherwise; he refused, and complained to the criminal lieutenant. A sentence of the Châtelet ended this dispute. (These last details can be found in Volume XXVI of the *Dictionnaire des Sciences,* Neufchâtel.)

I borrow from the Thesis of Mr. Nicolas, *Essai sur la transfusion du sang,* No. 79; Paris, 1860), the Châtelet ruling which he translated. This authentic piece offers too much interest not to be included in the physiological history of this issue.

Extract from the sentence given to Châtelet by the lieutenant of criminal cases.

Paris, April 17, 1668.

In this case, the following facts have been proven:

1. The operation of transfusion was performed twice on Mauroy, who was insane, and a third was tried. It succeeded so well the first two times that we saw this man enjoy all his good sense and perfect health for three months.
2. Since the first two operations, his wife has given him eggs and broth for food and slept with him four times. Despite the defence of those who treated him, and without speaking to them, she took her husband home, who went only with great reluctance.
3. Since that time he frequented public houses, took tobacco, and having fallen ill, 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 spoon on the ground.
4. Mauroy had frequent quarrels with his wife; she beat him even though he was ill; the latter having once thrown a box at her head, 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 consented to do so only with the permission of the Solicitor General. On the very day that the operation was started, 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 would not allow anyone to open her husband's body, giving the reason that he was already in the coffin, although he was not there.
7. Long after the death of said Mauroy, three doctors offered money to this woman to file a complaint, accusing the transfusion of killing her husband; she said, when these people had left her home, 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 state that Mauroy had died during the actual transfusion operation.

There is ample need to inform this case in a comprehensive manner and to examine this woman; to inform, in order to know what these powders were; why she gave them to her husband; who had 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 a third was undertaken at the urgent request of the woman, who, moreover, had very poorly 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 summoned to appear in person, and would be examined on the above information, and that more information would be taken on the contents of Mr. Denys' complaint, and that in the future transfusion could not be done in humans without the approval of a doctor from the Faculty of Paris. (Thesis, p. 15 et seq)

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

SECOND PERIOD

During this second period, which extends from 1668 until 1818, the transfusion of blood fell completely into oblivion. Just as it had been outlawed from French surgery by the edict of the Châtelet, an unfortunate case had it condemned by the court of Rome. Thus, during this period of one hundred and fifty years, find only a few mentions of them which have no importance. It is necessary to arrive at the beginning of the 19th century to witness in some way the resurrection of blood transfusion.

THIRD PERIOD

The third period of blood transfusion begins with the year 1818. Fallen into oblivion for a century and a half, an unfortunate circumstance was to bring it out. It was to have witnessed it that Blundell undertook experimental research on animals, which he soon applied to humans.

I have translated Blundell's memoir, and I would leave an unfortunate gap in the physiological history of this matter if I did not mention the experiences of this skilled surgeon in sufficient detail.

"A few months ago," said Blundell, "I was called to a woman who was wasting away as a result of uterine haemorrhage; the losses had happened before I arrived, 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 that gave it a special interest, I could not help but think that the patient could probably have been saved by transfusion, and although there was little opportunity for operate in the usual manner, the vessels could have been filled with ease and promptness by means of the syringe." (*Medico Surgical Transactions,* Vol. IX, 1818, p. 56)

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

FIRST EXPERIMENT

After the femoral vein was 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 appeared: difficulty in breathing, 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 (pp. 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 tube was inserted there as well as into the 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 to be inconvenienced (p. 59). However, for this experiment to be prolonged for twenty-four minutes, the same blood must have passed through the instruments several times.

This proves, even more obviously than the preceding experiment, that blood can be transmitted by syringe, and on several occasions, without becoming unfit for vital functions.

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

The experiments which I have just mentioned are not the only ones that have been done by the English surgeon; indeed, he relates 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, which had been in a vessel for *thirty to sixty seconds,* was inserted into the veins of several dogs; *they all died*, either immediately after the operation, some time later or after several days.

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

Blundell, fearing that the introduction of blood using the syringe would allow air to enter the vessels, and fearing the presence of this gas, investigated whether it could not be tolerated at a low dose without compromising life. For this, he tried some experiments, from which he concluded that the air, *if not in too large 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 add to these facts those that our own experiments have allowed us to see.

All the experiments reported up to this time were done with arterial blood; it was important to see if venous blood would produce the same results. Blundell's research taught him that human venous blood, introduced into animals, did not bring life back better than arterial blood.

After recounting these experiences, Blundell describes the device he invented to practice transfusion. It 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 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 the vein of a dog* – After causing three dogs to loose a fair amount of blood, Blundell transfused them with human blood. Immediately after the operation, the animals appeared to revive, but soon succumbed.

Blundell's experiments, in somehow resurrecting the transfusion of blood, were not to be without influence. Just as we saw during the first period from 1665 to 1668 the surgeons from all countries taking this issue seriously, so the example given by the English surgeon had to be followed; it was indeed, and numerous works appeared then.

In France, we see Mr. Milnes Edwards, the learned dean of the Faculty of Science in Paris, in his inaugural thesis for the doctorate in medicine in 1823, supported this proposition: in severe haemorrhages, one can have recourse to the transfusion of some blood.

Two years later, Mr. Prévost and Mr. Dumas concluded their research on blood cells with a few experiments on transfusion: *this unfortunately too famous operation, which has been so abused in an ignorant and barbaric century* (p. 226).

"If you take the blood that you inject into an animal of a different species, but the blood cells are of the same shape, albeit of a different size," 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 have some phenomena that we must not omit: the pulse becomes faster, the breathing keeps its normal state, but the heat drops with remarkable speed when it is not artificially maintained from the start of the operation; faeces become mucous and bloody, and retain this character until death; 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 a bird is injected with circular red cell blood, the animal *usually dies* in the midst of very violent nervous accidents, comparable in their speed to those obtained *by the most intense poisons*. They still manifest themselves, when the subject on which one operates has not been weakened by a notable loss of this liquid.

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

Sheep's blood transfused into ducks causes rapid and very strong convulsions, followed by death. Often we have seen the animal die before the 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 a few words on the issue that Mr. Blundell has recently attempted with success, but from a different point of view from 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 whole knowledge of the active ingredient of blood." (*Bibliothèque universelle de Genève*, p. 226 et seq., t. XVII, 6th year, 1821)

The previous 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.* (1st series, t. XXII, p. 99. 1810)

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

1. Immediate transfusion using an intermediate tube going from the artery of one animal to the vein of another.
2. Mediate transfusion, which is carried out by pushing blood 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 made numerous experiments with immediate transfusion; he reports eleven of them in his memoir. I will borrow only one from him, 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 more 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 he still did not survive.

This experiment was carried out 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 quickly. The other three dogs, the old cat, the sheep and the calf, gradually recovered and regained 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 happy cases, it is not without danger.

2. Effects of mediate transfusion with a syringe on animals exhausted by a severe haemorrhage.

All these mediate transfusion experiments were made 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 for *how long the blood drawn from the vessels retained its property of reviving an animal*.

He concludes from his experiences that after three hours it loses its effect.

This result is at odds with those of Blundell, who claims to have revived dogs with blood that had been out of the vessels for twenty-four hours.

The clotted and re-dissolved blood has only rarely brought back any signs of life, but there has never been a complete revival.

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

"I have never been perfectly successful," Dieffenbach says, "in reviving an animal with the blood of animals of a different species. Dogs were sometimes roused from their apparent state of death by the mediate transfusion of sheep or human blood, but most of them perished quickly, in the midst of 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, assures us that he brought a dog back to life by transfusing it with blood taken from a man, and that the animal survived the experiment perfectly. As for me, despite all the precautions imaginable, I have consistently failed."

In support of this assertion, Dieffenbach cites experiments in which human blood was injected into a cat, ox blood into a sheep and a dog; the cat and sheep died. Rabbit blood was injected into a cat; the animal died the same day. Calf's blood was injected into a cat after 24 hours in the air; the animal died.

After bleeding a dog in such a way as to render it *bloodless*, Dieffenbach injected it with an ounce and a half of beef blood, which had been in contact with the air for *forty hours;* breathing and circulation were accelerated at first, but gradually they returned to their normal character; the animal moaned a few times, the pupils dilated enormously, and after a quarter of an hour, when the experiment was over, the condition of the animal was such that one should expect a near death. However, after three hours, he was noticeably better, and after a few days he was fully recovered.

On the same animal, the experiment was repeated with beef blood drawn for *twenty-four hours*; only an ounce and a half of blood was drawn from the jugular; the same symptoms showed themselves at first; eight hours later the animal was dead.

From previous experiments, Dieffenbach concludes:

1. Blood retained for some time and kept liquid by agitation, then passed through a cloth and injected into the veins of an animal of a different species is promptly fatal.
2. A strong bleeding, carried to the point of syncope, can diminish the influence of foreign blood stripped of its vitality by prolonged contact with the atmosphere.
3. The injection of a certain amount of foreign blood that has remained exposed to air for a long time, and which, without prior bleeding, would be sufficient to kill the animal, does not produce this result when one begins to withdraw from the animal a considerable amount of its own blood.

The results obtained by Dieffenbach were soon to find a striking confirmation in the curious researches and interesting experiments of Bischoff.

Bischoff, by varying the experiments and not limiting them to the same class of animals, was to take a big step forward in the transfusion of blood.

After recalling, at the beginning of his memoir, the research of Muller, Prévost and Dumas and Dieffenbach on blood, he dwells, with a great deal of emphasis on the facts that seem to result from the experiments of these physiologists:

1. *The essential need to defibrinate the blood to successfully carry out a transfusion*; because one of the difficulties of this operation, along with one of the most serious dangers, is found in the speed with which fresh fibrin coagulates.
2. Diluted serum and fibrin cannot restore life in an animal that has lost a great deal of blood as a result of haemorrhage; hence the conclusion, that blood cells are the real *active ingredient* of this liquid (Dieffenbach).
3. The threshing of blood, used to remove its fibrin, as proved by Muller, does not affect the blood cells in any way.

Bischoff was surprised, however, that mammalian blood injected into birds can lead to devastating effects, because the blood cells of the former being smaller than those of others, should not stop circulation in the heart and brain (p. 349).

He therefore felt it necessary to make new experiments. They can be divided into three series:

1. Experiments in which mammalian blood was introduced into the veins of birds (hen, rooster, goose, duck) *after having been defibrinated*.
2. In the second series are those where the same operation was performed with *non-defibrinated blood*.
3. In a third set of experiments, Bischoff asks himself the following question: "Can defibrinated blood, borrowed from animals belonging to one species, bring back life if it is injected into the veins of an animal of a different species, when the latter has been severely depleted by considerable haemorrhage?"

TRANSFUSION OF MAMMALS TO BIRDS: The instrument used by the German physiologist is a small tin syringe containing two ounces of water. He mainly practiced mediated transfusion.

FIRST SERIES: Defibrinated mammalian blood injected into birds.

On 21 June 1835 he laid bare the right jugular vein of a young rooster, and injected it with a small amount of whipped [defibrinated] calf's blood, which had been drawn a few hours earlier from the carotid artery. The animal did not appear to be affected by this operation, and began to run into the room. No accidents having occurred, he did the same experiment on another rooster. The vagus nerve was tied during the operation without any accident. The two roosters survived, as did a third, to which he injected mixed arterial and venous blood, and which had previously been defibrinated (p. 351).

On 2 July, he injected into the right jugular vein of an adult hen a fairly large amount of *defibrinated arterial blood*, taken from a dog and heated to 36° Réaumur. The hen lost a fairly large quantity, but less than was injected into her. She appeared weak after the operation; her breathing was quiet; she soon recovered, healed perfectly, and lived until August 6, when Bischoff used her for another experiment.

A curious circumstance arose: the hen became wicked; she jumped in the face of all those who approached her, and even killed a few little chickens. This wickedness later diminished, but was not completely lost.

The same results were observed: firstly on a duck, which was injected with freshly defibrinated blood (p. 532); secondly on a dog, which received through the carotid an ounce of defibrinated and heated hen's blood (p. 352).

Conclusions: The defibrinated blood of mammals when injected into birds does not exert any deleterious influence on them.

SECOND SERIES: Experiments with non-defibrinated blood.

On July 26, he transfused a young rooster which had lost some blood with a certain quantity of fresh, *non-defibrinated* liquid which had been taken from a cat. After a few seconds the *animal had violent convulsions and died*, showing *all the symptoms of severe narcotic poisoning*.

The same result was observed in another rooster, which had been transfused with rabbit blood. He died immediately, although he had not had a haemorrhage, and the amount of rabbit blood introduced into his venous system was small (p. 353).

Bischoff removed most of the blood from a duck, and promptly injected it after defibrinating it. The animal came back to life; he removed it again and transfused it to him after having deprived it of fibrin again; the duck came back to life again (p. 354).

After finding, like Prevost and Dumas and Dieffenbach, that non-defibrinated mammalian blood quickly leads to the death of birds, Bischoff wondered whether defibrinated blood borrowed from a species, not producing death when injected into the veins of an animal of another species, could not have stimulating properties capable of bringing back to life an animal exhausted by haemorrhage.

On 28 July, to verify this, he laid bare the jugular vein of a duck and a dog; he inserted tubes into the vessels of these two animals, after having removed enough blood from them *to be in a state close to death*. After that, he injected the duck with defibrinated dog blood, and the dog with defibrinated duck blood. Neither animal returned to life.

On August 6 he took a hen and a rabbit: of the first, which he had exhausted by a previous haemorrhage, he injected defibrinated blood from two rats; the hen did not revive. The rabbit also received defibrinated blood from two roosters, to no avail.

Fearing that he had not taken all the necessary precautions in these experiments, which had not yielded any negative results, Bischoff made another report on December 8. After having stripped the right jugular vein of a goose with the utmost care, he placed a tube in it. The cephalic end of the vessel having been previously tied, he removed blood from the carotid artery of two rabbits, defibrinated it by beating, and raised it to a temperature of 34° Réaumur. He then removed the ligature placed on the vein, and *soon the haemorrhage put the goose in a state of apparent death*. At that moment he pushed through the tube four small syringes of defibrinated rabbit blood: no beneficial effect ensued, and the goose remained dead.

From these three series of experiments and those of Prevost and Dumas and Dieffenbach, Bischoff draws the following conclusions:

1. Fresh blood from a non-defibrinated mammal, injected into the veins of a bird, produces death in a matter of seconds, causing violent phenomena similar to those observed in poisoning.
2. Defibrinated mammalian blood, injected into a bird, produces no phenomena similar to the previous ones, and the animal remains alive without a functional disorder.

3. Defibrinated blood has the property of recalling to life animals in a state of apparent death, *only when injected with animals of the same species*. However, as in the defibrinated blood the blood cells have descended into the serum, and as the numerous experiments cited up to this moment prove that the serum does not have the property of reviving animals when it is injected alone into the vessels, it follows that it is the blood cells that possess the invigorating principle.
4. The property which the blood of mammals has of producing death in birds, cannot come from a mechanical obstacle to circulation, since the blood cells of the former are smaller than those of the latter, and, on the other hand, blood cells being the invigorating principle of the blood, it follows that it is the fibrin which, *as a result of its exit from the vessels, passes from the state of dissolution in which it is during life, to the state of coagulum*, contains this deleterious principle. Consequently, this principle not having, in animals of the same class, a direct action on the re-establishment of life, and producing fatal effects from one class to another class, *it will be useful and advantageous to defibrinate blood when one wants to perform a transfusion*.

If the experiments which I have just reported are correct, if it is true that phenomena similar to those of poisoning occur when the blood of an animal is injected into the veins of another that does not belong to the same species, and that these phenomena do not show themselves when the blood has been defibrinated by beating, the conclusion formulated by Bischoff is of the utmost importance and must be taken into serious consideration.

But does this proposal not raise a question that comes naturally to mind: Is it correct to say that fibrin is a toxic element, and is it not rather the speed with which blood coagulates in mammals and birds that one should attribute the accidents observed? In short, if coagulation can be prevented by mixing an alkaline solution, or by any other means, would the fibrin remaining in the state of dissolution produce death, as Bischoff's experiments seem to establish? This rapid ending, so fatal, *is it not the result of the introduction into the vessels of blood which is half-liquid, half-coagulated*, and is there not in the phenomena which precede death some similarities with those determined by embolisms? This is a delicate point, and on which I will have to explain myself later, by carefully repeating Bischoff's experiments, and by varying the conditions of the experimentation.

I will not follow this experimenter in the applications he has made of transfusion to frogs and fish: it would unnecessarily lengthen this history.

The Memoir whose conclusions I have just quoted, is not the only one Bischoff has published on the transfusion; new research is found in the Muller Archives (1838, p. 351), which is also of great interest.

After drawing a certain amount of blood through a dog's crural vein, he injected it into the jugular of a very strong rooster. The animal went into convulsions and immediately succumbed. Taking *arterial blood* from the same dog, he transfused it into a hen, which was severely dejected, but eventually recovered. The latter, on the contrary, succumbed, in the midst of convulsions as a result of the introduction of venous blood into her vessels.

Some time later he repeated this experience on another rooster; the result was the same. Bischoff concludes: *That the arterial blood of a mammal does not cause death when it is introduced into the veins of a bird, and that venous blood alone brings this ending*.

After Bischoff's experiments come, in order of date, those of Giovanni Polli, published in the *Archives de Médecine* (p. 205, No. October, 1852). Here is the summary.

All we have to do is report the conclusions of this Memoir:

1. An animal, *which has been reduced to the extremity* by the loss of arterial blood caused by a wound to a large artery, *is soon brought back to life* and restored to its functions by injecting into its veins the same defibrinated arterial blood (1st and 2nd Exp.)
2. If the arterial haemorrhage was produced by the opening of several arteries, and caused the complete death of the animal, it is not revived by the injection of its defibrinated arterial blood, *by the reason* that the heart, which has become immobile, does not allow the blood stream to pass (3rd Exp.)
3. If an animal has been deprived of a large amount of venous blood to the point of falling bloodless to the ground, and that it is injected with a good part of this defibrinated blood, it is revived to the point of getting on its feet (4th Exp.)
4. An animal may receive the previously defibrinated blood into its veins, without danger or only with a few temporary accidents, albeit of lower density (5th Exp.)
5. In an animal, a significant amount of its own blood can be injected with impunity, although it has been extracted from its body for twenty-four hours; that it was beaten, defibrinated, passed through a sock; left in the open air in a tinned copper vessel, at a temperature of 9° centigrade. Stirred again at the time of being used, and heated in a water bath up to 35°, it could be introduced with advantage into the veins of a young horse.

Giovanni Polli's experiments, always carried out with defibrinated blood, support the conclusions formulated by Bischoff, but do not present anything new, except for this rather curious fact than of great utility, *that the fibrin-deprived blood still retains life-giving properties twenty-four hours after leaving the vessels*.

The study of blood transfusion has made little to tempt young doctors, because I have searched in vain in the inaugural dissertations of the Faculties of Medicine of Montpellier or Strasbourg for a single Thesis on this issue.

Among the Theses of the Faculty of Paris, I found five that deal with this subject: those of Mr. Carré (1844, No. 214), Mr. Achille Perrier (1851, No. 195), Mr. Passement (1852, No. 172), Mr. Lepine (1856, No. 211); and finally the more recent one of Mr. Nicolas (1860, No. 795). The first four are good monographs on blood transfusion, but which, in no way, do they contain new facts unique to their authors.

The Thesis of Mr. Nicolas, a more complete report from an historical point of view, recounts the experiences made by this young doctor. It is fair to mention them. Mr. Nicolas' first experiment was to test whether an animal, in which breathing has stopped occurring, can be revived by transfusion.

Blundell had already done this experiment, and we have seen previously that out of seven experiments, six had been unsuccessful, only one had been successful.

Mr. Nicolas, repeating this question, combined the use of transfusion with electricity. Here's how he did it:

From a small rabbit, Mr. Nicolas removed twenty-seven cubic centimetres of blood. At the end of the haemorrhage, which lasted for twelve minutes, the animal cried out, yawned a few times, and had convulsive movements. Three minutes after the end of the haemorrhage, the heartbeat and respiratory movements had completely ceased, the pupils were dilated, the animal remained motionless. Twelve minutes after the haemorrhage, he began to electrify it with an induction device, one pole being applied to the epigastric region, the other to the anterior region of the neck. Every five minutes, the power was interrupted for two or three minutes.

Thirty minutes had passed since the end of the haemorrhage when the transfusion was performed. Twelve cubic centimetres of arterial blood taken from another rabbit, and brought to the temperature of 7° centigrade, were injected through the jugular; the injection lasted six minutes. The electrification was continued for five minutes; the animal remained motionless; death became obvious. *Autopsy* – All the organs are discoloured, the vessels and the heart are almost empty.

In a second experiment carried out in the same way, the same results were obtained. Are we not entitled to think, by reading the peculiarities of these two experiments and the details provided by the cadaveric examination, that these two rabbits had long since died when the application of the currents and the transfusion began?

What happy result could the experimenter therefore expect, under these conditions, from the use of this double means? Mr. Nicolas then dwindles on a point that I will study myself later, and whose importance cannot be concealed: *I am talking about the temperature that the blood that is used for the transfusion must have*.

After reporting the experiences of Hunter, Scudamore, Blundell and Davy, he recounts his own experiences, the conclusion of which can be formulated as follows: The cold, far from producing the coagulation of blood, seems on the contrary to prevent it and when we want to attempt the transfusion we will now know that to keep it liquid, it is best to cool the vessel and the syringe (p. 39).

This opinion had already been expressed by Professor Malgaigne in his *Traité d'anatomie chirurgicale* (1st Vol. p. 480, 2nd Edit.).

Here, moreover, are the experiments on which Mr. Nicolas bases this opinion: In a large rabbit, the carotid artery was opened, and blood was allowed to flow until the heartbeat and breathing movements stopped. The temperature was considerably decreased, the pupils were dilated; the animal had lost sixty cubic centimetres of blood. Six minutes after the end of the haemorrhage, he injected into the jugular vein *ten cubic centimetres of arterial blood* taken from another rabbit, and brought it *to a temperature of eight degrees centigrade*.

The injection lasted five minutes. Two minutes after the operation, some slow and weak breathing movements, and a slight twitching to the pre-cordial region, manifested themselves. After six minutes, the animal is untied and walks with difficulty. The temperature remains low, the heart beats weakly. Twelve minutes later, the heartbeat is still weak, but it is rushed. After thirty minutes, these beats are very sensitive, less precipitated, but closer to the normal type; finally, an hour and a half after the operation, the animal walks and takes food; respiratory movements, circulation, temperature, are in the normal state.

In a second experiment on a rabbit, the animal lost fifty-five cubic centimetres of blood. Mr. Nicolas injected it with *ten cubic centimetres at eight degrees centigrade*. The phenomena indicated in the previous experiment manifested themselves again, and two hours after the operation the functions of life slightly fulfilled. The animal was quite lively; he took food and fled when approached.

In a third experiment, after removing fifty cubic centimetres of blood from a rabbit, Mr. Nicolas injected it with *ten cubic centimetres of arterial blood at nine degrees centigrade*. Twenty minutes after the operation, the heartbeats which had stopped, as well as the breathing movements, were in the normal state.

These three experiences are of great interest; they show that *it is unnecessary for the blood to have the same temperature as that of the body*, for coagulation to be delayed. Secondly, they show that in three animals from which *fifty cubic centimetres of blood has been removed only ten cubic centimetres were needed to restore life*, after an hour and a half or two hours, or twenty minutes, when experimenting with arterial blood.

Finally, Mr. Nicolas studied the influence of defibrinated blood. He reports only one experiment, although he has achieved happy results on several rabbits.

Sixty cubic centimetres of blood having been removed from the animal, the following phenomena manifested themselves: Cessation of the heartbeat and respiratory movements, complete resolution of the muscles, dilated pupils. Eight minutes later, twelve cubic centimetres of blood defibrinated by threshing and borrowed from another rabbit, were injected. The injection lasted three minutes. The transfused liquid was at a temperature of 25° centigrade. The operation had been

over for three minutes, when heart movements and breathing began to become sensitive.

After six minutes, the temperature was still low and the heartbeat was weak. For two hours, the heartbeat remained weak, the temperature rose only slowly, but the animal eventually recovered.

On October 19, 1857, Mr. Brown Séquart reported experiments on venous and arterial blood to the *Academy of Sciences*. As a result of these experiments that red blood increases the vital properties, but is unable to bring them into play by stimulating them; while black blood is an energetic stimulant of the nervous system and also to a lesser degree of nerves and contractile tissues, but what it does have, or at least has only to a very small degree, the power to maintain, and even less to regenerate vital properties.

In a second note issued on November 30, 1857, Mr. Brown Séquart concluded:

1. That the blood of a vertebrate animal of one species is not a poison for vertebrates, even of a very distant species.
2. The toxic action of the blood of an animal injected into the vessels of an individual of another species depends principally, when it exists, on carbonic acid in sufficient quantities. *(Reviews-Accounts of the Academy of Sciences,* p. 562 and p. 924. 1857)

I will have to explain myself later on these facts.

CONCLUSIONS

From all the above, we are entitled to conclude**:**

1. That when an animal has been reduced to a state bordering on death as a result of considerable loss of blood, it can be immediately brought back to life by transfusion (Richard Lower, Denys, Blundell, Bischoff, etc.).
2. That the quantity of blood necessary to produce this result *is always much less than that which the animal has lost*.
3. That arterial blood and venous blood both possess the ability to revive the animal, but their action is different: the first, the red blood, gives the tissues *the ability to act, the power*; the second increases *the action and uses this power* (Brown Séquart).
4. The transfusion, in order to be successful, must be made with blood belonging to animals of the same class, but above all of the same species; for while Blundell has demonstrated, like all experimenters, that dog blood revives the dog, he has also proved that human blood does not possess this property; for all the animals, except man, who received it in their veins, quickly succumbed.
5. If an animal of one class is injected with blood taken from an animal of another class (mammals and birds), it succumbs almost immediately, presenting phenomena that offer a great deal of analogy with those of poisoning (Bischoff).
6. The experiments of Prévost and Dumas, Dieffenbach and Bischoff, show: (1) that the serum of blood injected alone into the vessels cannot revive an animal about to die by haemorrhage; (2) that if the blood of a bird is defibrinated and injected into a dog, it does not cause accidents. It was therefore rational to conclude that fibrin acted in some way as a toxic agent.

   The consequence of this last fact is the need to *defibrinate the blood to perform transfusion* (Bischoff, Giovanni Polli, Nicolas).

Without deciding the issue definitively, the experiments of Mr. Nicolas seem to show that low temperatures delay coagulation of blood. New experiments will be necessary to fix this point with certainty.

PART TWO
PATHOLOGICAL HISTORY OF BLOOD TRANSFUSION

The physiological history of transfusion has led me to demonstrate that, performed on animals, this operation had almost always been followed by a successful result; it has also proved that it was not only on these, but on humans, that Denys, Emmeretz, Richard Lower, used it with success. All these facts were to encourage doctors to take the path that had been opened to them, and to fertilize this bold thought, by imitating the example given by the surgeons of the 17th century.

Was this example followed? Has the transfusion of blood been carried out on man, has it acquired a right of domicile in science, and do the results which it has provided deserve the harshness that many, even today, still bear against it? These are serious, serious, difficult questions that I will consider in this second part of my Memoir.

To arrive at a precise solution, I have researched all the Scientific and Medical Collections, and I have tried to collect all the facts that have been published; these facts are numerous.

I will report them without altering them, as I have already said, neither in substance nor in form; it is the best way to put those who will read this work in a position to establish their conviction on an irrefutable basis, and it will be for me the surest way to legitimize the conclusions to which my research has led me. If I do not have any personal comments to add to all the ones I am going to report, it is because the opportunity to practice transfusion has not yet been offered to me: if it does present itself, I will seize it eagerly.

In order to bring order and clarity to my work, I will classify all known facts into eight groups:

1st GROUP: Blood transfusion performed in cases of metrorrhagia
2nd GROUP: Blood transfusion performed in traumatic haemorrhages
3rd GROUP: Blood transfusion performed in anaemia by various causes
4th GROUP: Blood transfusion performed in madness
5th GROUP: Blood transfusion performed in cancer
6th GROUP: Blood transfusion performed in diarrhoea, vomiting, severe dysentery
7th GROUP: Blood transfusion performed in cases of pulmonary phthisis
8th GROUP: Contains observations where transfusion has been affixed by poorly defined morbid states

FIRST GROUP
Blood transfusion performed in cases of metrorrhagia

1st OBSERVATION

Blood transfusion performed in a case of metrorrhagia by Mr. Waller and Mr. Doubleday

The woman who is the subject of this observation was of a delicate constitution and lymphatic temperament. By the time Mr. Waller went to her home, the waters of the amnion had flowed. The delivery was rapid, and even took place in Mr. Waller's absence. When he returned to the patient, he found her lying on her back; her face was extremely pale; the whole body was discoloured, showing the apparent signs of death; there was not the slightest trace of redness on the lips; the extremities were cold, swallowing impossible and breathing movements imperceptible; the pulse exhibited long intermittences.

This condition had been caused by a very abundant haemorrhage that had followed the expulsion of the placenta. The application of cold on the belly and heat to the extremities was done; brandy and ammonia were administered to the exterior. Under the influence of these stimulants, the pulse appeared to raise a little, the blood stopped; the patient was wrapped in woollen blankets. Despite the use of this treatment, the cold became general. Mr. Waller then consulted Dr. Blundell as to whether it would be appropriate to perform the transfusion. For the two hours that followed this determination, the pulse, which had risen a little, fell again, and it became apparent that the blood loss had continued. The patient was in a very alarming state of syncope when the operation was performed.

Blood was drawn from the arm of the patient's husband and received in a large glass. Dr. Blundell filled the syringe with it as it flowed, and having inserted the tip of the instrument into the opening of the patient's vein, he pushed the liquid into it with great care. This first injection of two-ounces appeared to produce no effect; but towards the end of the second the symptoms that herald syncope manifested themselves, the pulse fell a little, the patient sighed deeply and made efforts to vomit, without rejecting anything. These accidents, quite similar to those that often follow a slightly heavy bloodletting, stopped spontaneously after one or two minutes. The pulse, which before the operation was 120, had dropped to 100; but it still retained its weakness.

Six hours later, Waller and Blundell saw with great satisfaction that the patient had recovered considerably. Her pulse then offered 100 beats; it was much firmer. She complained of being hungry; she was were then allowed some nourishing but not exciting foods; she did not experience any untoward symptoms; she slept well, and a restful sleep; she never complained about this particular state of the head, so common after a violent haemorrhage; there was no need, moreover, to administer any medicine, except a teaspoon of castor oil, which provided abundant evacuations. This state of irritability of the digestive tract is, as we know, very ordinary in cases of this nature: the wound on the arm does not unite by first intention, and was not completely healed until several days after, while the patient was in a very satisfactory state of health.

2nd OBSERVATION

Metrorrhagia following childbirth; transfusion; healing (November 1825) by Mr. Doubleday

Mrs. Cochlin, twenty-nine years old, of a strong constitution, gave birth to a daughter on 28 November 1825. The birth was not accompanied by any accidents; only the placenta adhered strongly to the walls of the uterus, and Mr. Franks, in whose care the patient was entrusted, employed all ordinary means to procure deliverance. After two hours, the haemorrhage increased alarmingly, and the hand was inserted into the womb to detach the placenta, which was still strongly adhered to the bottom of this organ. Mr. Franks called for me, and when I arrived I found the contracted womb on the placenta, which was beginning to be expelled; but before and after her discharge, the patient lost such a large quantity of blood that she fell into syncope; and when I entered the room, her appearance made me believe that death was imminent; we no longer felt a pulse on your wrist; the face was bloodless, lips discoloured, nostrils pinched, eyesight obscure, extreme agitation, breathing accelerated and interspersed with frequent sighs; the whole body was covered with a cold, sticky sweat.

I immediately ordered the patient to take six ounces of brandy. This method raised the strength a little and made the pulse perceptible; it was continued to be used at short intervals, adding carbonate of ammonia and laudanum. They persisted in the use of this method for half an hour, with almost no advantage: the pulse was

sometimes sensitive and accelerated, sometimes quite imperceptible. Seeing that we gained nothing under the influence of these means, I saw no more chance of salvation for the patient other than in transfusion.

Mr. Blundell came with me to this woman; he was perfectly of my opinion. However, she was no worse then; but a careful examination of the pulse, the appearance of the countenance and the large amount of blood she had lost, made this doctor think that death was imminent and that the operation should be attempted. The husband was then proposed, who not only accepted it, but offered to provide the blood that would be needed.

Mr. Blundell then proceeded to perform this operation, isolating the median cephalic vein; but the patient refused so stubbornly, that he was obliged to give it up, without having any hope of preserving the woman's life by any other means. However, I begged Mr. Blundell to leave me the syringe, determined to renew the attempted operation as soon as the patient was on the verge of death. I placed the patient in the care of Mr. Franks, recommending that he continue the use of stimulants. At two o'clock in the afternoon, that is to say more than six hours after the end of the haemorrhage, this doctor told me that the patient was rapidly losing her strength and that I would probably no longer find her alive. I hastened to return, and I found her in the worst possible way; she had already been given twenty-five drachmas of brandy, one hundred and sixty drops of laudanum, a large quantity of ammonia carbonate and three egg yolks mixed with brandy, broth and oatmeal.

Since we had no time to waste, and the woman's friends wanted me to try the transfusion, I immediately passed a blunt needle under the vein that Mr. Blundell had exposed, and I made an opening large enough to insert the cannula of the syringe; meanwhile, Mr. Franks compressed it slightly on the needle so as not to lose blood. The vein of the patient’s husband was immediately opened wide, and the blood was received in a conical glass; I filled the syringe immediately, and after taking all the usual precautions so that there was no air, we adapted the cannula to the opening of the vein, and we gently passed the blood with caution. *As soon as it was injected, the pulse rose noticeably, became wider* and the appearance of the lips and face greatly improved. After a second injection, which was followed by a third, which made a total of six ounces of blood, the patient's condition was much better, and she was feeling so well, that she cried out that she ‘was as strong as an ox’.

During a fourth injection of two ounces of blood, she said she could feel the blood flowing through her veins; the pulse was much raised; it was even quite strong, and the patient was perfectly well; two more injections of two-ounces were made, bringing the amount of injected liquid to fourteen ounces; the pulse continued to gain strength; but after the seventh injection the patient complained of mild pain above the left eye. I stopped then, and closed the opening of the vein in the ordinary way. The pulse, which before the operation gave 140 barely noticeable beats per minute, offered only 104, a quarter of an hour after 98, at the end of a quarter of an hour 90; it was generally very full, a little soft and irregular. At the end of the first hour after the operation, the patient sat on her seat, and with the help of the guard, cleaned herself and even dressed herself as if after an ordinary delivery.

The day after the operation, towards evening, we noticed that there had been a slight inflammation in the course of the vein. Eighteen leeches were applied in two batches, and the inflammatory symptoms disappeared. The secretion of milk was very abundant, the breasts painful, which necessitated frequent breastfeeding. Seven days later, the patient was cured. (*Archives de Médecine*, 1st series, t. IX, p. 566. These two observations are taken from the *London Medical and Physical Journal*, May 1825).

These two observations, by demonstrating the successful effects of transfusion, reveal three circumstances that we will see reproduced in almost all cases: (1) the harmlessness of the medium, (2) the speed with which it operates, (3) the difference

between the amount of blood lost as a result of haemorrhage and the amount that is necessary to awaken the action of the ready-to-extinguish heart. I content myself with pointing out this last fact, for it will lead me later to formulate an important practical conclusion.

3rd OBSERVATION

Uterine haemorrhage; blood transfusion; healing, by Mr. Waller

The woman who is the subject of this observation had been in bed for three weeks, and she was so exhausted by vomiting and continuous nausea that she no longer had the strength to roll over on her own in bed; she was seized with the labour pains at about three o'clock in the morning. Mr. Waller went there at about ten o'clock. For five hours she had experienced a violent haemorrhage, which only increased; the pulse was barely responsive at the wrist, and the overall weakness was extreme; the child presented the shoulder. Mr. Waller hastily made up the version and finished the delivery. The weakness increased so rapidly that Mr. Waller said, "I hardly believed the attempt I was about to make." Assisted by Mr. Doubleday, Mr. Waller opened the vein in her arm and injected thirteen grams of blood taken from a robust man. The patient, as we knew from her, was so weak that *she could no longer see or hear*, that she could not speak and that she did not feel the instrument that opened the vein; and that she had no idea what was being done to her. This first attempt did not seem to produce any effect; perhaps, however, the pulse was more sensitive; but from that moment on, the extreme agitation that had previously existed ceased completely. Five minutes later, thirteen grams of blood were injected; the pulse became sensitive, but it was very weak. After five minutes, a quarter ounce of blood was inserted into the vein; the result was a great improvement in the pulse, which offered 140 beats per minute. The patient, from that moment on, was able to answer all the questions. Half an hour later fifteen grams of blood, taken from Mr. Waller's nephew, a young man of fourteen and in good health, were injected; the results of this latest injection were even more apparent. The overall condition of the patient was considerably improved; the pulse, quite strong, gave 130 beats per minute. The overall appearance was satisfactory, the heat good.

That same evening, at eight o'clock, Mr. Waller found the patient better. On the seventh day after the operation, she was able to stay up for thirty minutes; on the twelfth, she was in full recovery. (*Archives*, 1st series, t. XII, 290, 1826)

4th OBSERVATION

Transfusion performed in a case of metrorrhagia; death as a result of the entry of air into the veins, by Drs. Georges Jewel and Bayle (1826)

A woman was reduced in extremity as a result of a metrorrhagia, which occurred after childbirth; the pulse was insensitive, the extremities cold, and the whole body bathed in a sticky sweat. Large doses of opium, ammonia salt, etc. had been used unnecessarily when it was decided to perform the transfusion; which was done through the jugular vein, the veins of the limbs being in no way apparent; the syringe contained about three drachmas. Her husband allowed the necessary blood that was needed to be taken from him and which was received in the basin, which itself was plunged itself into a vessel filled with hot water. In twenty minutes, the contents of the syringe were injected sixteen times; and because little blood was released each time the syringe was inserted, we can estimate that only four ounces of the amount was inserted into the jugular.

During the operation, the patient had nausea, and towards the end she suddenly turned her neck, and became agitated each time the injection was repeated; but a few moments later she sighed a few times and died.

Thinking that this accident was the result of the introduction of air into the vein, Dr. Jewel and Dr. Boyle started the autopsy; and after tying the superior and inferior vena cava, as well as the pulmonary artery, they removed these vessels with the heart, and placed them all in a vase full of water and above a bell filled with the same liquid. A puncture was then made in the heart, and immediately two large bubbles of air went into the bell, which, together, might have displaced about a drachma of liquid. The heart also contained very little clotted blood; the uterus was empty. (*Archives*, p. 590, t. 1827, XIV, 1st series)

The importance of this observation cannot go unnoticed, as it demonstrates that one of the most formidable complications of certain surgical operations can occur while transfusion is performed; I mean *the introduction of air into the veins*. Since the autopsy was carried out with care, and the presence of this gas found in the right ventricle, it is impossible to doubt that this was the cause that determined the death. So this is a serious objection against transfusion. We will see how we responded to it in the Part III of this Memoir; let us say, however, that this fatal result was easy to predict, *since the jugular had been opened at a point where the venous pulse was manifested*, and where the suction of the chest could be widely exercised. We are right to accuse the transfusion of this failure, and, is it not fair to attribute it rather to the manner in which the operation was performed? In any event, it follows from this observation a practical conclusion, which is that *blood should never be introduced through the jugular*, and that, in the event that it is impossible to do otherwise, the surgeon should only open the vessel at the point where the venous pulse no longer appears.

5th OBSERVATION

Metrorrhagia; transfusion; healing, by Dr. Klett (1828)

A delicate woman who had had several children and whose periods had disappeared several times suddenly suffered on 17 January 1828, from a metrorrhagia which, moderate at first, soon became very abundant. The haemorrhage had lasted eighteen hours when Dr. Klett was called, who found the patient exhausted, pale, with sagging features, weak and barely sensitive pulse.

The loss of blood had been profuse; fomentations with brandy on the lower abdomen were prescribed; their hands and arms were washed with mulled wine; a potion was administered with ratanhia, cinnamon water, cinnamon tincture and acetic ether; at the same time, astringent injections were made into the uterus. The patient's condition became more and more alarming, the weakness and haemorrhage increased, everything seemed to herald an imminent death.

In this desperate state, Mr. Klett decided to perform the transfusion, which was performed with great skill by Mr. Schraegle. Two ounces of blood taken from the patient's husband were injected; *the effect was surprising, the patient opened her eyes almost instantly*; the pulse became sensitive again, and raised again, the hiccups diminished and ceased completely, the face regained its natural appearance and the heat suddenly appeared to succeed the icy cold of the body.

Soon the patient regained her strength. On the request: what had been the sensation she had experienced at the time of the transfusion, she replied that she had felt a strong and distinct stream of warmth towards her heart, which had given her a new life. (*Medical Gazette*, 1834, p. 744)

6th OBSERVATION
Another case of transfusion followed by success, by Dr. Klett (1828)

On 17 February 1828, a month after the previous case, Dr. Klett was called to the wife of a winemaker, who for ten hours had suffered an abundant loss. The alarming signs mentioned in the previous observation were already showing, and when Dr. Klett arrived, the patient was saying her last farewell in a weak and broken voice; she looked like a dead woman. Encouraged by his first success, Klett had a surgeon inject two and a half ounces of blood provided by the husband.

The result of this operation surprised me as much as the assistants, who until that moment had been incredulous about the effectiveness of this means. Life seemed to be revived as if by an electric shock. The loss was stopped by haemostasis, and health soon restored. (*Archives gen. De Médicine*, 2nd series, t. VI, p. 117)

The two preceding observations are remarkable, first of all by the double success that confirms the usefulness of transfusion, but above all by the surprising speed with which life was restored.

7th OBSERVATION
Transfusion performed successfully on in a case of uterine haemorrhage, by Dr. Brown

Following her tenth childbirth, a lady, who had already experienced profuse discharge several times, suffered from a violent external haemorrhage, which in a short time reduced her to a desperate state.

Indeed, the extremities were cold, the breathing slow and stertorous, the eyelids closed, the pupil dilated and insensitive to light, the lips trembling, and the pulse imperceptible to the wrist and even to the carotid artery. The most energetic stimulants were used without any success, and a few convulsive movements that followed their use aggravated this painful state. Finally, Mr. Brown, in desperation, resolved to attempt the transfusion. He therefore injected thirteen grams of blood into the middle vein. Five minutes later, no change having occurred, he repeated the injection with the same amount of blood; the pulse then began to be felt in the radial artery; breathing appeared to become easier, and pupils less dilated. After ten minutes, a third injection of the same amount, and then obvious improvement; regular pulse, 120 beats per minute, and a return of swallowing movements. Finally, the injection was repeated for the fourth time; the patient regained consciousness, and appeared to be returned to life. A violent reaction manifested itself, but did not have any unfortunate consequences, and the person recovered perfectly. A total of six and a half ounces of blood was injected into the middle vein. (*Edinb. Med. & Surg. Journ.*, April 1828)

8th OBSERVATION
Uterine haemorrhage during pregnancy; transfusion; healing, by Dr. Savy (1829)

Ms. Goudin, thirty-six years old, of a sanguine temperament, was in the third month of her fifth pregnancy when, with no known cause, on 19 August 1829, she experienced various bouts of colic followed by a metrorrhagia, which became increasingly disturbing. Dr. Savy employed all means he thought fit to prevent imminent danger; but everything was useless, and the warning symptoms of death began to show themselves: pulse extinguished in almost every part of the body, except in the pre-cordial region where a dull tremor is still felt; almost unresponsive breathing, universal freezing cold, dull eyes, pale lips, limbs falling under their own

weight. Dr. Savy sees no other resource than transfusion. Pressed by the emergency and in the middle of the night, he takes a small ordinary tin syringe which he plunges into lukewarm water. A robust girl offers herself to provide blood. As soon as the dying woman receives about four ounces of fluid, she regains her senses; failures cease, the best is pronounced little by little, and health is restored. (*Journal universel des Sciences médicales*, t. LVII, p. 153)

There is a peculiarity in Savy's observation that we will soon see represented in the work of Mr. Marmonnier, and which is well worthy of attention: this is the way the operation was carried out. Instead of using a well calibrated injection syringe, like the one used by surgeons, which allows only very rare air bubbles to mix with the liquids it contains, this doctor took a tin syringe that was at hand, and he did the transfusion with it without worrying about everything that was defective in its mechanism, and yet the operation was successful, and the patient was saved.

How can we explain and justify, in the presence of facts of this kind, this opinion so universally accredited, that transfusion is an unnecessary operation when it is not dangerous, and which has almost always given nothing but failure?

9th OBSERVATION

Uterine haemorrhage; transfusion; healing, by Dr. Goudin (1829)

Mrs. G., 36, was in her third month of pregnancy. With no known cause, on 19 August 1829, at noon, she suffered from a rather severe colic, which was followed by a discharge from the vulva. This haemorrhage, at first infrequent, became more and more disturbing towards evening, to the point of giving rise to syncope. (Ice compresses on the lower abdomen, thighs and genitals.) Little suspension of the blood flow. (tamponade) The loss was stopped; but after an hour, the tampon is expelled during the colic. (New tamponade) After each colic, some blood escapes from the lower part of the vulva. Therefore, complete failure; the pulse fades, a general cold spreads all over the body; the eyes darken, and life seems ready to be extinguished. The tampon is carefully removed. (Dry cups on the breasts, warm linen on the chest and extremities, injection of vinegar water) The patient only temporarily recovers her senses. The pulse goes out; there is still a dull tremor in the pre-cordial region. Nothing changes for three hours. Mr. Goudin imagines resorting to transfusion. He uses an ordinary eight-ounce syringe; he heats it to the degree of body heat; he cuts the median cephalic, which is felt by the patient. A few drops of black blood flow through the incision; he then receives heated blood in the syringe, which he draws from a robust girl, and fills two-thirds of it. The cannula is suitable. We make sure that there is no air by making a jet of blood come out. About four ounces are slowly transfused. The patient regains her senses, and says that she felt the heat along her arm. From that moment on the patient recovered. Healing was supported by appropriate treatment for haemorrhage and quinine sulphate for feverish paroxysms. (*Journal des Progrès*, 2nd series, t. II, p. 236)

10th OBSERVATION

Uterine haemorrhage; transfusion; death, by the Interns of the Hôtel-Dieu (1831)

In 1831, the interns of the Hôtel-Dieu practiced the transfusion in a woman who had a vicious insertion of the placenta; the version was practiced immediately; but the patient was already so exhausted by the losses she had suffered before entering the hospital, that the transfusion could only prolong her agony for a few hours. (*Bulletin de Thérapeutique*, t. I, p. 164)

11th OBSERVATION

Uterine haemorrhage; transfusion successfully performed by Dr. Schnecmann of Hanover; healing (1833)

A thirty-year-old woman, in good health, had already had two children, and with each childbirth profuse haemorrhage before the delivery of the placenta. At her third delivery, the child had been born for two hours, and the placenta had not yet been extracted, and a violent haemorrhage occurred. Dr. Schnecmann, called in, found the patient fainting; breathing and circulation were barely noticeable. The haemorrhage had ceased momentarily; he prescribed wine mixed with tincture of cinnamon; knowledge returned, and he busied himself with extracting the placenta and the clots in the uterus. This organ immediately contracted, and the haemorrhage did not return; she again took wine, several grams of ergot rye, a little laudanum, and she found herself so well that the doctor left her. A short time later, as the woman turned over in bed, the haemorrhage returned violently; everything indicated an imminent end. Dr. Schnecmann saw no cure except in transfusion: he operated with an ordinary syringe with a rather long cannula; the husband provides blood; seven to eight ounces of blood were injected. Thirty minutes later, the woman came to; and after three hours, with the help of wine and other tonics, she was wonderfully recovered; the haemorrhage did not return; a phlebitis took place, but nevertheless strength and health reappeared; the patient retained only pallor. (*Medical Gazette*, 1833, p. 465)

12th OBSERVATION

Uterine losses defies all means; transfusion; healing, by Dr. Banner, of Liverpool (1833)

Mrs. HI..., twenty-eight years old, delicate, married at the age of nineteen, had four children and twenty-two abortions. Her last delivery took place in September 1832. On 26 April 1833, she was seized with a loss of blood from her vagina, which, after the evacuation of several clots, stopped for some time; the haemorrhage reappeared in intervals until the 30th, when Dr. Banner was sent for.

The patient claims to have returned a clot with a membrane bag on the 27th, but the doctor was not able to verify this assertion; the pulse was regular, the tongue clear, the skin warm, the thirst light, the stools normal without colic; the haemorrhage provided a scarlet blood, which was scanty; the patient had continued to care for her house, and had not changed her way of life; the following mixture was prescribed from four in four hours: sulphate magnesia; infused with roses; diluted sulphuric acid, five drops. By 1 May, haemorrhage had almost completely ceased; there had been several bowel movements. On the 2nd, the patient found herself so well that she thought she could look after her household. This premature exercise caused the haemorrhage to reappear; he pulled out a clot that weighed six ounces. Through rest and cold lotions, the haemorrhage was suspended; the pulse was weak. When the patient raised her head, she felt dizzy; the mouth was dry, thirst was intense; she complained of pain in her armpits that went down the thighs. On the 4th, after a little improvement, the haemorrhage resumed; sleep was stirred by dreams; considerable excitement, frequent and small pulse, very intense carotid and temporal beats; cold applications further suspended the flow of blood; thirty-five drops of laudanum were prescribed. On the 5th, opium produced some sleep, the metrorrhagia is permanent, but to a small degree; the language is lightly charged, the pulse (80) is weak. Towards evening, it was at 76; the above mixture was continued, replacing the sulphate of magnesia with nitrate of potash; a small amount was prescribed. Until the 8th, the haemorrhage presented alternatives to augmentation and suspension; opium, cold enemas, and ice poultices were used. On the 8th, the weakening was

considerable and the loss had increased; a scruple of ergot rye and a cold enema with the alum were prescribed. The third dose was followed by vomiting; five doses were taken in succession with no apparent effect on the uterus. At eleven o'clock in the morning, the pulse was barely perceptible; depression, stupor, hiccups, vomiting; the loss is scanty, the blood is ruddy; ice-water was injected with some benefit into the vagina. This dose was repeated every ten or fifteen minutes; a little brandy was taken. At one o'clock in the afternoon, the patient seemed to die off rapidly; the loss was still flowing, though scanty; you could feel the pulse from time to time, breathing was slow and weak, the eyes half closed and glazed, the urine flowed involuntarily; hiccups from time to time; the finger was inserted into the vagina, which contained a large clot, the cervix open enough to admit the finger; a thin membrane protruded from the inside of the cervix; it was removed with the clot; the uterus contracted slightly on the finger; ice cold water was injected, and a tampon was introduced. Throughout this whole operation, the patient seemed deprived of feelings.

In *desperation*, blood transfusion was used.

Blundell's apparatus was used; an incision was made in the fold of the arm, and the vein was exposed in an area of about three-quarters of an inch. The apparatus was immersed in hot water and placed in a suitable position; a ligature was tightened around the arm of the patient's husband; the vein of the latter being opened, an untied pipe was inserted, which was held there by an assistant; then the husband's vein was opened wide and the blood of flowed continuously into the machine. After expelling all the air from the jet of the pump body, the elastic tube was connected to the small pipe placed in the patient's vein. When the quantity of blood in the pump body had been pushed out five times, the breathing was so hampered that we were obliged to stop. After a rest of a few minutes, the pump was again filled twice; breathing became even more difficult; the pulse became perceptible and as if in disarray. Dr. Banner had some difficulty pushing the piston as he introduced the last portions of the blood; which he attributes to the need for the thickening of the blood while the patient's lungs were allowed to rest. She gave no sign of feeling; the wound was simply bandaged. After the transfusion, the pulse remained disordered, sometimes imperceptible; breathing was barely perceptive; the body became cold and covered with viscous sweat; the patient appeared to be dying; she remained in this state until three o'clock in the afternoon. Then the pulse could be felt on the wrist, the breathing became more regular; she was able to swallow small amounts of weakened brandy. If she swallowed more than a teaspoonful at a time, she was taken with a hiccup that caused a lot of anxiety; the symptoms became more favourable aspect until eleven o'clock; the patient became agitated, often changing places; the pulse was faster and stronger; she became thirsty, a painful heat to her head; the tongue was covered with a brownish colour, although wet; the phenomena varied from hour to hour; sometimes sagging, insensitivity; sometimes agitation. Stimulants were given: soda-water, cold drinks. From seven o'clock in the morning until eleven o'clock in the evening, the patient took half a pint of brandy in small doses and a considerable amount of port wine without her pulse being influenced. On the 9th, the patient was better in all respects; the pulse was weak, but more regular; breathing more normal, less thirst and restlessness. Brandy, soda-water, veal jelly made liquid by heat, were administered in small quantities every ten or fifteen minutes; there was urine retention, probably because the tampon compressed the neck of the bladder; the catheter caused a good-natured urine to flow. On the 10th, a fetid discharge comes out of the vagina, urine retention continued; no bowel movement since the operation; dirty tongue; pulse of the operated arm 110, while the pulse of the other arm is 90; mild pain and numbness of the first; the wound progresses towards healing. The catheter was reinserted and the tampon was removed, which was covered with foul matter, his ablation produced great relief; a small dose of castor oil was given and repeated in the evening, and produced an evacuation. Then the pulse went down, the appearance was better. This woman

gradually recovered little by little by the use of mild tonics and a suitable diet. It was not until the seventh day of the operation that the pulses were similar in both arms, the patient having previously offered an accelerated pulse. On the fourteenth day, she was able to change her bed. On the twenty-first, she left for the country. (*The London Medical and Surg. Journ*. June 8, 1833. *Archives*, 2nd, t. III, p, 128)

13th OBSERVATION

Metrorrhagia; transfusion; healing, by Dr. Ingleby (1834)

Mrs. Hill, of a delicate constitution and of a very small but well-built stature, was a mother of three children. I have, says Mr. Ingleby, assisted in all her deliveries. The first one happened fortunately. In the second, half an hour after the expulsion of the placenta, there was a haemorrhage that I could not stop by compression, and which demanded the introduction of the hand into the womb. The third delivery began on Thursday, at ten o'clock in the evening, accompanied by vomiting and pain that gave the patient no rest. At two o'clock in the morning, the next day, I was summoned to her because of a haemorrhage that had just appeared. I found the cervix dilated with a crown; the membranes were flaccid, but the water pocket extended into the vagina; the blood was flowing profusely. At this time of labour, as the head had descended into the pelvis, I immediately ruptured the membranes, and the haemorrhage ceased completely for half an hour; it was soon renewed, but the child was soon expelled, and after two pains the delivery took place spontaneously. I placed my hand above the pubis, and discovered the uterus reduced to its smallest dimensions; it was in as good a state of contraction as possible; the pulse was perfectly natural, and the bandage was firmly applied. Recalling what had happened after the last delivery, I stayed in the apartment, and I did not allow the patient any movement. After ten or fifteen minutes, she warned me that she was fainting; the pulse could hardly be distinguished, and the uterus, soft and distended by the blood, occupied a large part of the abdomen. I resorted to friction and pressure; I emptied the womb of the blood that it contained and used cold affusions on the lower abdomen, according to the method recommended by Goach and Chapman. The uterus was often drained of the blood it contained, but it dilated, and this condition was accompanied by great weakness; the pulse was barely felt, the sweat was cold. I inserted the left hand into the uterine cavity and carried it to its bottom, and with my right hand I put pressure on that part. A servant during that time was making cold affusions. I should note here that these means were not without success; the patient was constantly shouting for water, water. This water, falling, hit the lower abdomen and seemed to relieve it. I gave her a small amount of brandy, but the action of the heart was not restored. My friend, Dr. Knids, came to help me and brought some ergot rye.

Prior to his arrival, the patient had lost the ability to swallow and had fallen into a complete state of insensitivity. Having stopped the haemorrhage, and having managed to bring the uterus back to its ordinary size, despite the softness of its walls, I withdrew my hand after keeping it there for more than a quarter of an hour without having taken it out once. During this time, I had the opportunity to appreciate the alternative effects of contraction and dilation. Every time I thought my hand could be removed, the dilation and flaccidity of the walls came back. This state happened several times; the weakening always increased, the pulse became more and more imperceptible; hot bricks were applied to the feet, a bladder full of hot water was held over the heart region, and the bandage was tightly secured at eight hours. Four hours after the delivery, a teaspoon of laudanum was carried with difficulty into the throat. The patient had been in a full state of jactitation and profuse perspiration for half an hour; her features were drawn, breathing was difficult and noisy by the passage of air through the mucus contained in the bronchi; the laudanum managed

to calm the agitation, but it had no other favourable result; the pulse was faster and more imperceptible than before.

This case seemed to me to offer the indication of transfusion. Six hours had passed since the delivery with no sign of reaction. The patient was cold, the pulse was unresponsive, and her position appeared perilous. Dr. Wood was consulted: he approved the operation, which I proceeded with immediately. The syringe, which could hold four ounces of fluid, was filled with venous blood drawn from the husband's arm, and after chasing two drachms with the water in the tube, I injected the rest into the middle vein of the right arm that had previously been opened. This injection was done slowly and in a regular manner; the patient felt nothing of this operation, but Dr. Wood noticed that in less than five minutes the pulse on the opposite side was more instinctive than before the operation.

After thirty minutes, the patient regained the feeling; after an hour, there was a general improvement; the pulse of the right arm was always imperceptible; broth was taken in small quantities. Nine o'clock on Friday evening, the pulse had not yet been felt in his right arm, but on his left arm it was beating 140 times; the arm was outstretched and swollen, and thirst was strong; during the day on Saturday, the pulse was weakly distinguished in the right arm; in his left arm, it had gained strength and was beating 130 times. Nine o'clock in the evening, there was no difference between the two arms; beating on both sides 130 times. The abdomen was large, gas-filled and painful; fomentations were made, and a purgative enema of chamomile and soap was administered. Eight hours before noon on Sunday, the pulse was 120 beats; the breasts were flaccid; since then, the improvement has been gradual and unabated. (*Arch. de medicine*, 2nd series, t. IV, p. 339, 1834)

14th OBSERVATION

Metrorrhagia; transfusion; healing, by Dr. Berg (1835)

S..., thirty-nine years old, tall and lean, of a sanguine temperament, had, during her first delivery (10 October 1833), a strong haemorrhage as a result of the adhesion of the placenta. On 25 April 1835 she gave birth to her ninth child; although this time the placenta came out spontaneously, the delivery was accompanied by a strong haemorrhage which soon yielded to the properly employed means. On the 29th, the patient, against the will of the doctors, got up a little every day; but as she had a slight haemorrhage each time, she remained, from the 2 to 11 May completely in bed. On 11 May she had a severe haemorrhage at around noon; above the pubis, you could still feel the womb; the belly was soft, not swollen, quite insensible; the woman was cheerful, her pulse sub-frequent, soft, but not weak. She was prescribed: decoction of tormentille roots, infusion of sabine grass diluted in phosphorus acid, cinnamon syrup, to be taken by spoonfuls every two hours, then five packets of ergot rye every hour. Although the haemorrhage had diminished, but not ceased, we had recourse, moreover, to injections of a decoction of sabine grass with alum at two o'clock; at five o'clock the haemorrhage had continued, the weakness was great; the patient spoke only slowly and with effort; she was quite pale, face seized, breathing laboured; some vomiting; pupils dilated, pulse frequent and small, no failure yet. In addition to the medicines that were continued, acetic ether was occasionally given with tincture of cinnamon. They continued in this way until eight o'clock in the evening; then the haemorrhage ceased almost completely for half an hour, but the patient's condition became more and more disturbing; fainting and continuous hiccups occurred, the extremities were cold, the breathing very difficult, jerky, the pulse barely sensitive. Death seemed imminent at every moment. *The transfusion was undertaken*: slowly and very carefully, to prevent the entry of air, *two and a half ounces of blood taken from a healthy man*

were injected. The effect was not as surprising as on the two patients of Dr. Klett: the patient remained for a few more moments without movement, but soon it was noticed that the breathing became freer and less jerky; the pulse became sensitive and the hiccups ceased.

After eight minutes, the patient opened her eyes and spoke; she had not felt anything about the operation. The haemorrhage did not return, and after four weeks, during which the patient was given adequate fortifying medications, she was fully recovered. (*Gazette médicale*, p. 381, 1838)

15th OBSERVATION

Childbirth accompanied by remarkable circumstances; presentation of the placenta; metrorrhagia; death, by Dr. Jackson (1836)

A delicate thirty-year-old woman, born to phthisic parents, entered Guy's hospital on 3 December 1836 to give birth to her ninth child. She states that this pregnancy is unlike any other; she complains of discomfort to the womb and usually coughs.

On the 18th of the same month, rising from her bed, she was seized with a very sharp cough which was followed by a uterine loss of half a pint of blood; her face and body immediately become bloodless; pulse, 100, irritable; dyspnea, anxiety, constipation; the following potion is prescribed: diluted sulphuric acid, sulphate of magnesia, infusion of roses, cold drinks, few blankets on the bed, horizontal position, raised pelvis, rest.

In the evening, improvement; pulse, 82; cessation of haemorrhage. The patient complains of pain in the limbs (opium pills); the same treatment is continued for several days; the weakness disappears.

On 14 January, the patient sent for Mr. Jackson; profuse haemorrhage from the vulva, caused, according to her, by a moral emotion (same treatment, to which is added the application of vinegar compresses to the hypogastrium). The bleeding is suppressed; uterine pain occurs and brings back haemorrhage; small pulse; general abatement; the pain returns for twenty minutes in twenty minutes, and is accompanied by the issue of large blood clots; flow of amniotic fluid; touching shows that a small portion of the placenta has come out through the opening of the cervix. Dilatable tanche muzzle; the child's head is felt through the placenta; twenty-five grams of tincture of opium and rest are prescribed. Two days later, dyspnea, general depression, weak pulse (brandy in water, by spoonfuls). Mr. Lever is called and immediately practices the version, and delivers the woman in the presence of Mr. Arswhell. Consecutive haemorrhage: tight abdominal bandage; pallor, syncope. At three o'clock in the afternoon, Mr. Twedie performed a transfusion on the patient using Mr. Lever's blood; he injects seven ounces into the middle basilica vein; the pulse rises instantly and the woman seems to come back to life as if by miracle; she opens her eyes and speaks; an hour later, however, she fell back into the same state of annihilation. Mr. Arswhell performs a second transfusion, using the blood of the woman's husband; life recovers for an instant, then the patient collapses and expires an hour later. (*Gazette médicale*, 1837, p. 460)

The author takes this opportunity to question the usefulness of transfusion in cases where it appeared to be successful; he thinks these patients could have lived without this operation. "When", the brain is really collapsed, as in the previous case, "the transfusion has no lasting effect on it".

The account of the last three experiments is the best answer to Dr. Jackson's reflection: "If the transfusion had been practiced at the beginning of the haemorrhage, and before any other means one would be entitled to think that stimulants, haemostats, compression, would have been enough to overcome the accidents." But in the two patients of Banner, Liverpool and Ingleby, haemorrhage

had manifested itself several times, and by more or less abundant losses, which had determined a progressive weakening. Dr. Ingleby's patient seemed predisposed to this accident, for in her previous childbirths she had been prone to metrorrhagia. However, all means had been put into use, both inside and outside, and it was only when their ineffectiveness was sufficiently demonstrated and death was imminent that transfusion was thought of as an extreme resource. Therefore, this assessment does not seem better founded than that expressed by the same observer, when he says: "If the brain is really collapsed, as in the previous case, the transfusion has no lasting effect on it."

Is it, of course, that it is the collapse of the brain that determines death as a result of haemorrhage, and is it not more rational to think, from careful examination of the facts, that it is mainly due to the lack of action of the heart and the tonicity of this organ?

16th OBSERVATION

Uterine haemorrhage following natural childbirth; transfusion; healing, by Dr. Richard Olivier (1841)

A forty-three-year-old woman had uterine haemorrhage following a natural childbirth, accompanied by syncope and followed by a coma. After administering high doses of rum, ammonia and opium, transfusion was performed: twelve ounces of blood were introduced without making any appreciable changes; eight ounces were injected again; the improvement was gradually being shown; at the end of the injection, recovery was complete. (*Revue médicale*, 1841)

17th OBSERVATION

Metrorrhagia; transfusion; died seven days after transfusion, by Professor May (1841)

Dr. May, an English physician, reports a case of transfusion performed to remedy a haemorrhage that occurred after childbirth, and maintained by the stay in the uterus of part of the placenta. He transfused twenty-four and a half ounces of blood; the patient's condition improved, the rest of the placenta was expelled, and the haemorrhage did not reappear. But symptoms of uterine phlebitis developed, and the patient died seven days after transfusion. The autopsy could not be done. (*Revue médicale*, 1841, t. I, p. 294)

It is regrettable that this observation is not more detailed, and above all that the autopsy could not be done; but it seems impossible to attribute death to transfusion. Indeed, the haemorrhage was arrested, death prevented, and the condition of the patient improved by the introduction of foreign blood into the veins. If this woman died, it was as a result of uterine phlebitis; however, this fatal ending too often complicates the layers, so that we are authorised to be able to find here a cause-and-effect relationship between it and the transfusion.

18th OBSERVATION

Post-puerperal uterine haemorrhage; blood transfusion; primitive success, died the twenty-first day from metroperitonitis, by Professor Nélaton (1850)

In the 18 December 1850 session of the Society of Surgery, Professor Nélaton communicated the following observation:

A young woman of twenty, having arrived at the end of childbirth, goes to St. Louis Hospital; she had been tired from haemorrhages due to the insertion of the placenta on the cervix. The interns, under whose direction she had been placed for part of the day, had done all that needed to be done. The ergot rye had been given, and Mr. Lescun had attempted to make the version. Haemorrhage had been especially profuse from three o'clock in the afternoon to nine o'clock in the evening. At that time, the patient was considered dead by the sister and the nurses. The director was then notified, and Mr. Nélaton was asked; he arrived at eleven o'clock in the evening, and found the patient in the following condition: she is inanimate, the skin is cold; the pulse, barely perceptible, offered intermittent vibrations. The version is immediately practiced by Mr. Nélaton; he goes in search of the feet, completes delivery, detaches the placenta, and stimulates the uterine contractions with the help of the hand placed in the cavity of the womb. Haemorrhage stops, but the heat does not return; the pulse persists in the same state, as well as the pallor, despite the Bordeaux wine, Bagnols wine, the broths and all the external means that had been used to restore the strength of the patient. After an hour and a half of unnecessary use of these means, Mr. Nélaton performed the transfusion as follows:

The median cephalic was laid bare, a thread passed under it with the help of a stylus. This vein was incised obliquely, so as to have a small flap that could be easily picked up. The end of a hydrocele syringe was received into the inside of the vein; the body of this instrument, as well as the paddle that was to receive the blood, were kept at 35^{o} centigrade. Mr. Dufour, an intern at the hospitals, provided the blood that needed to be transfused. In a first injection, made slowly, about two-thirds of the blood in the syringe was made to penetrate; in a second injection done in the same way, about half of it was made to penetrate. The heart, after this transfusion, showed no breathing sound; the pulse was a little raised; the precordial anguish had ceased, as well as suffocation; the thirst was then great. The wine and the broth were continued with abundant drinks.

The next morning, the patient complains of fatigue; the heat has returned, the pulse is developed, the breathing is good.

On the second day of the operation, there was a reaction and tension of the breasts occurred. On the fifth day, the pulse is 104; the patient is well enough, but during the day a shiver occurs that makes her fear for her life; the vein is not inflamed.

The improvement persisted for several days, and everything promised a happy ending; for the flow of the lochia, notwithstanding the anaemia of the patient, had manifested itself, and milk fever had established itself in a normal manner; *some abdominal pains appeared on the seventh day*. The patient eventually succumbed on the twenty-first to puerperal metroperitonitis.

The reflections I have made in connection with the facts published by Dr. May are applicable in that of Professor Nélaton. In the first case, the patient succumbed on the seventh day to a *uterine phlebitis*; in the second, the twenty-first day, to *metroperitonitis*. These disease states show themselves too often after childbirth, when transfusion has not been performed, for one to be able to accuse him of having determined them. We cannot therefore consider this last observation as a success, compromised by one of these complications which tend to become more and more frequent nowadays. The importance of the name of the surgeon given in this observation who performed it cannot be concealed.

19th OBSERVATION

Metrorrhagia; transfusion the simplicity of the device used to operate it; healing, by the Dr. Marmonnier (1851)

On 3 January 1851, Mr. Marmonnier was called to see a thirty-year-old woman, lymphatic and weakened by successive pregnancies. The expulsion of the fetus could not take place because of a very pronounced inversion of the womb, Mr. Marmonnier made the version by the feet; a greater loss than usual occurred, and forced the surgeon to quickly extract the placenta and excite the contractions of the inert womb. This manoeuvre was successful, and the loss stopped; three quarters of an hour later, the loss reappeared very strongly and was terminated by fainting; she reappeared a second time, and the fainting continued.

Mr. Marmonnier, called again, made astringent and refrigerating applications, gave a concentrated infusion of ergot rye, a cordial potion, dry lotions on the skin, etc., etc. Nothing improved the patient's condition; everything seemed hopeless when Mr. Marmonnier, remembering Mr. Nélaton's observation, thought of giving the transfusion. He used a child's syringe, which could hold seventy grams of blood, and uncovered the basilica vein, made a three-centimetre incision, passed a thread under the vein, with which he was able to lift it, and received the blood of a girl in a vessel containing hot water. To keep blood warm, he placed the cannula of the syringe in the opening of the vein and slowly pushed the blood out; soon the syringe plunger stopped and the surgeon immediately stopped; he began the operation again, being careful to wrap the syringe in a cloth soaked in hot water, and this time all the blood contained in the instrument entered the vein. Ninety grams were thus introduced; no incidents, no pains occurred.

Immediately after the transfusion, breathing became more regular, the pulse stronger; syncope ceased, the treatment already indicated was continued; two hours after the operation, improvement occurred, the patient fell asleep, and from that moment the recovery was rapid. After twenty days, the patient was cured; after thirty, she resumed her occupations.

This is simply achieved and simply told, say Mr. Dechambre and Mr. Diday, a beautiful and legitimate success; but there is more than praise to be given to the author for the firm and prudent decision he has shown on this occasion. Above all, his conduct will have the great advantage of instilling in practitioners a confidence they lacked. In public opinion, the transfusion of blood, in order to be successful, not to be dangerous, requires a very special dexterity, a complicated instrumental apparatus, and educated aids. Well, seeing it carried out happily in the countryside, by a doctor whose first title is illustrated, without any instrument other than those in his kit, without any auxiliary other than inexperienced villagers, the practitioners, I have no doubt, will regain courage, and Mr. Marmonnier will have deserved better from the science than he himself perhaps hoped, by the example of both boldness and circumspection that he was given to provide. (*Gazette médicale*, p. 427, 1851)

I will add nothing to these remarkable words, which seem to me to be a fair reward given to the eminent practitioner, except that his example has been little followed to this day, as it is difficult to uproot a prejudice or a preconceived idea.

20th OBSERVATION

Metrorrhagia; following abortion; extreme anaemia; imminent death; blood transfusion; cure by Mr. Devay and Mr. Desgranges, of Lyon (1851)

On 25 October 1851, Mr Devay was brought to Marie Guene, aged 27 and working in Lyon as false jewellery worker.

This girl, of a fairly strong build, is laying on her bed, motionless, her eyelids still, her eyes dull, her features downcast and her face extremely pale. "This is a serious haemorrhage;" was Mr. Devay's first word when he saw the patient. It was soon learned that this woman, following a premature birth, had had such a profuse

haemorrhage in the days before that, according to those who accompanied her, she had lost all her blood.

At that time, this patient presented symptoms that could not leave any doubt about the existence of haemorrhage. Mr. Devay then prescribed a potion with Bonjean's ergotine, one gram, and ratanhia syrup, thirty grams.

The next day, there was no improvement. Mr. Devay thought that transfusion was necessary; it was performed by Mr. Desgranges, chief surgeon, in the presence of Messrs. Darne, Caudy, Bourlet, physicians of the hospice, and Messrs. Morel and Berne, interns. Mr. Desgranges used the hydrocele syringe.

The median basilic vein, having been isolated, was opened, and the blood supplied by Mr. Lardet, the service's intern, was injected at the dose of one hundred and eighty grams; the syringe, previously heated, had been surrounded by compresses soaked in boiling water.

The pulse, which before the injection was 130 beats, rose to 138 towards the end of the experiment. Soon the artery began to beat-resistant; ventricles offer regular contractions, their power had doubled; the devilish sound that existed to the carotids disappeared; the sick woman's eyes opened, and she seemed to pay attention to those around her; in a nutshell, all the new phenomena indicated that a profound change had suddenly been imprinted on the entire situation.

The general excitement that had manifested itself after the transfusion increased. During the rest of the day, and on the night of the 26th to the 27th, there was even a little delirium.

After a series of better and worse alternatives, the patient regained her strength, and on 29 November she left the hospital completely cured.

Tonic, ferruginous and astringent preparations were administered since the time of transfusion. (*Gazette médicale*, 1852, p. 4 & 34)

The observation is followed by reflections to which I have nothing to add, and which can be summed up as follows:

1. Transfusion, as a heroic agent, must have a place in practical medicine
2. It must be reserved for extreme cases, for the sole purpose of sustaining life
3. The amount of blood transfused should always be very small
4. Pure blood alone should be used
5. The operating manual does not require any special instruments
6. Under these conditions, it is physiological

21st OBSERVATION

Profound anaemia caused by repeated uterine haemorrhages; transfusion; healing, by Dr Bellasies-Malfen (1851)

Called to a woman of thirty-eight, pregnant with her second child, and reached the fourth month of her pregnancy, who had since the previous day suffered from a disturbing uterine haemorrhage, Dr. Bellasies-Malfen first practiced tamponade. Unsuccessful, he administered ergot rye, which caused severe pain and led to the expulsion of a two-month-old fetus. However, a quite abundant haemorrhage continued. The patient was extremely weak, without a pulse, almost imperceptible, vomiting everything she was taking, and in a state close to syncope. Nearly seven days had passed since the abortion. Mr. Malfen did not hesitate: a four-ounce bloodletting was performed on a robust servant, the blood received in a tin syringe heated to the temperature of 44° centigrade, and injected with great care into the veins of the left arm. *As the injection continued, awareness returned a little* and the pulse appeared slightly perceptible in the other arm; but half an hour later, the pulse had disappeared again, and consciousness was again lost. Another injection of three ounces of blood into the veins of the right arm. Same effect as the first time.

Third injection of three ounces of blood an hour later. This time, the good effects were more lasting: the pulse gradually rose as the blood entered the veins; the face coloured, and the patient asked if she was being bled. In the evening, there was thirst, insomnia, with frequent vomiting. But the pulse, though excessively frequent, was sensitive to the wrist; the pulse, which was still at 150, fell on the fourth and fifth day as the patient was taking food. Bruises had formed around the wounds of the veins of the arm; applications of lukewarm water were made; nevertheless, on the right arm there was a beginning of phlegmon which did not reach suppuration. On the fifth and sixth day, she was considered to be out of danger, and recovery suffered no difficulty. (*Bulletin de thérapeutique*, t. XL, p. 428, 1851)

22nd OBSERVATION
Successful blood transfusion for haemorrhage occurring during childbirth as a result of a uterine inversion, by Professor Soden (1852)

A lady, in labour with her third child, gave birth quickly. The last pains were so violent that the uterus suddenly expelled its contents and overturned. A stream of blood escaped, and the patient fell into weakness; the placenta was detached, then the reversal was remediated, and no further bleeding occurred. But after a quarter of an hour, the childbirth remained weak, pale, unconscious, bloodless in appearance, with a stertorous, jerky breathing, and returning only at long intervals. She could only barely swallow some stimulants. All other means were used to get her out of this state. An hour having passed, everything seemed to go from bad to worse; swallowing was impossible, and breathing became increasingly scarce. It was then decided that transfusion was necessary.

The cephalic vein was opened, and blood taken from the patient's husband by means of an ordinary nickel syringe, previously well heated, was injected. First, the liquid did not pass and returned through the opening of the vein; but gradually the resistance of its walls gave way, and the blood, though pushed with care and gentleness, was able to enter the vessel.

The effect was instantaneous; a convulsion invaded the whole body, and the muscles of the face were violently twisted. No more than one ounce of blood was injected; the convulsion quickly dissipated, the patient gradually recovered, but it was an hour before her pulse was felt on her wrist; she did not regain consciousness until the morning of the next day. During this time, she was continually given stimulants; she remained even weaker for some time; but since then she has had another child, and is now doing very well. (*Gazette médicale*, 1852, p. 674. Extract from the *Dublin Medical Press*, during April, May and June)

In addition to the success achieved in this circumstance, Dr. Soden's observation offers a remarkable peculiarity: *it is the small amount of blood that was necessary to produce the cure*. The patient received only an ounce of foreign blood.

23rd OBSERVATION
Metrorrhagia; transfusion; healing, by Dr. Brigham (1852)

A 20-year-old woman was extremely exhausted by a profuse uterine loss following childbirth; she had not spoken for six hours, when Dr. Brigham injected two ounces of blood into her arm vein. Then again, after every ten minutes, ten or twelve ounces in all. After the second dose, the pulse rose, and the face brightened. This patient came back to life, as if by miracle, as a result of the injection; her speech returned, and a few hours after the operation she fell into a deep sleep for several hours, after

which she awoke in good condition, and has since moving quickly towards a full recovery. (*Archives*, 1852, p. 336)

24th OBSERVATION

Uterine haemorrhage successfully treated by blood transfusion, by Dr. Wheateroft (1857)

Mrs. W..., forty years old, mother of several children, had had serious haemorrhages at several of her deliveries. When I saw her for the first time before her last childbirth, she had discoloured skin, small limbs, soft flesh; there was a great general weakness in her. Work began on 16 September 1857; I found the membranes ruptured, the pains repeated and moderately severe; the presentation was natural. An hour after my arrival, the birth took place, soon followed by delivery. The uterus contracted well, it only drained a few drops of blood. I applied a bandage around the stomach. I left the patient's bedroom; and after being away for about ten minutes, I came back to her, when I heard from the stairs a noise similar to that made by flowing water, and I rushed into the room of the birth. *My foot slipped in a pool of blood that extended at least four feet from the bed*, the sheets were completely soaked by blood, and the patient was in a truly alarming state. The face was as pale as that of a corpse, the eyes dull and glassy, the arms hanging out of the bed, the pulse extremely small and almost imperceptible; the abdominal bandage had fallen off; the round solid uterine globe, which could be easily distinguished through the walls of the belly immediately after delivery, was then replaced by a considerable distension of the womb.

I immediately understood that a blood transfusion was urgent. The patient, considerably exhausted by the haemorrhage, called in a weak voice to her husband whom she bade farewell, recommending her children to him; immediately after her mouth closed, then slowly reopened, revealing the pale and discoloured gums; the eyes became dull and leaden, the nose pinched, large drops of sweat came out on the forehead; the breath was cold and the radial pulse imperceptible; heartbeats were very weak and intermittent; from time to time, a stronger, more convulsive beat.

By the time I could get my transfusion set, though I had been as eager as I could, the heart had completely stopped beating. Finally, I promptly bled the husband; and opening the woman’s middle basilica vein, I transfused her with sufficient force six ounces of blood. *Immediately she took a deep breath, and the heart began to beat again*. I injected another six ounces of blood, the eyes then opened the lips coloured a little, the radial pulse became sensitive, and the heartbeat regained some strength. The patient took a few deep breaths; then, moving her eyes around the room, she said: I am better, where have I been? Wasn't I dead? Where is my husband, my children? Finally, I injected another six ounces of blood. The patient's condition improved more and more; the heart beats, still agitated, had an almost normal intensity; the radial pulse was fuller, the beats of the carotid artery were well marked, the eye was good. Raising her hands to heaven, she thanked God that I had saved her from certain death.

The healing was complete and rapid.

25th OBSERVATION

Uterine haemorrhage; transfusion; healing, by Dr. Wheateroft (1857)

Mrs. B... called me at the end of last October; I had known her for a long time, having assisted in several of her childbirths. All but one of her children had died in seizures before reaching their first year.

She is a thin, pale, exceedingly weak little woman; she was three months pregnant when I saw her in October; she sent for me because she had been suddenly seized, in the midst of her housework, with a profuse haemorrhage from the vagina. I found her at the bottom of the stairs unable to move. On the floor *a large clot and a large pool of blood* was enough indication of what it was. I carried her to her bed, and immediately she had the most terrible haemorrhage I have ever seen. It is easy to guess the symptoms that immediately arose: the skin was viscous and cold, the radial pulse imperceptible, the breath cold; considerable agitation, delirium; sunken and leaded eyes, weak and irregular heartbeat, retracted upper lip showing gums, open mouth, discoloured tongue and lips. I dabbed the vagina and administered stimulants. After half an hour, after taking a little brandy, the patient's condition was markedly improved, and after twelve hours all alarming symptoms had ceased; there had been no recurrence of blood flow.

I had just left the patient, whom I had left in a satisfactory state, when a person who looked after her, had lifted her so that she could urinate; the tampon was immediately pushed out of the vagina, and there was another haemorrhage. They came to fetch me in all haste, and when I arrived, I thought for a moment that the patient had died. Certainly never was syncope more marked. Ether, ammonia, and brandy, had no effect. I therefore proposed the transfusion, which was accepted; I injected ten ounces of blood, but I still obtained no marked change in the patient's condition. However, she took a deep breath. I injected another six ounces of blood; the lips coloured slightly, the eyes made some movements, and there was a few faint beats in the carotid artery. Encouraged by these favourable symptoms, I gave a third injection of six ounces of blood. The resurrection was complete: the skin became warm, the radial pulse became distinct again, the action of the heart easy, and the breathing almost normal. The healing was complete.

It should be noted that this woman, so skinny and so pale for several years before this haemorrhage, is now, since the transfusion of blood, fatter, colourful, and much better than before. (*Union médicale*, 20 October 1858, p. 467. Extract from *British Medical Journal*, April 1858. Reflexions.)

26th OBSERVATION

Haemorrhage after an abortion with the expulsion of the placenta; transfusion; healing, by Dr. Higginson (1857)

Complete prostration as a result of rapid blood loss; the mother’s sister provides the blood, and ten or twelve ounces were easily injected; *the success was immediate and striking*, no untoward symptoms hindered the restoration of health.

27th OBSERVATION

Haemorrhage from placental detachment, the foetus not being expelled; transfusion; death, by Dr. Higginson

Rapidly exhausting haemorrhage; the placenta had been detached, the child's head occupied the opening of the uterus, and the haemorrhage was occurring. The skin had a livid tint, as in the period of cholera asphyxiation. A maid provides the blood; there were already six or eight ounces injected, when a jolt of the patient brought made the instrument come out of the arm; the blood clotted, and prevented the operation. The patient died within half an hour.

28th OBSERVATION
Haemorrhage from adherence of the placenta, the uterus emptied, cessation of haemorrhage; transfusion; died on the seventh day, by Dr. Higginson

Twelve ounces of blood were injected; the patient *lived seven days*, and then she died. *The uterus was filled with pus*; there was no sign of disease in the veins, even in the uterine region, or in the arm where the incision had been made for the injection.

29th OBSERVATION
Partial detachment of the placenta; haemorrhage before delivery; transfusion; death, by the Dr. Higginson

Partial detachment, profuse haemorrhage; the woman weakened, neither the foetus nor the placenta were expelled. However, haemorrhage ceased; the blood injected was dark and thick; it hardly produced any effect; no more than five to six ounces had gone in; a little hot water and common salt were then injected, which activated the circulation; deliverance came quickly, but life was extinguished before it was complete.

30th OBSERVATION
Placenta detached by efforts, deliverance and consecutive haemorrhage; transfusion; improvement in the patient's condition; return of haemorrhage; death, by Dr. Higginson

(*Liverpool Med. Chirurg. Journal*, January 1857. – Dr. Higginson's observations can be found in the *Archives de Médicine*, 50 series, t. X, p. 346. 1857)

I will discuss Dr. Higginson's observations later, and hope to demonstrate that transfusion is unrelated to death.

31st OBSERVATION
Uterine haemorrhage; transfusion; healing, by Professor Martin (1857)

The Press borrows the following facts from a newspaper from across the Rhine: The *Augsburg Gazette* cites an example of one of the most curious operations in medical art: the transfusion of blood, which consists, as we know, of passing blood from the veins of one individual into those of another, to replace blood lost in a haemorrhage or by any other cause. Such an operation, performed in Jena on 20 May 1857, by Professor Martin, saved a young woman in great danger following a haemorrhage. It is a young man, a pupil of Professor Martin, who spontaneously offered the blood of his veins for this wonderful experience, and his act of dedication had all the desirable success: the young lady is out of danger. *(Moniteur des Hôpitaux,* p. 544. 1858)

32nd OBSERVATION
Uterine haemorrhage; transfusion; death, by Drs. Lever and Bryant; 1857 (Guy's Hospital, London)

Jeanne S..., 45, living in Deptford, was admitted to Dr. Lever's ward on 20 May 1857. She first felt severe pain in her back and kidneys for the first time ten years ago.

Seven years previously she suffered from a first and profuse haemorrhage that frequently recurred. She did not believe she had any tumour, except for the last twelve months, when she presented for the consultation at Guy's Hospital. In the last few months, she had profuse and numerous haemorrhages, accompanied by very intense pain. For the past three weeks, she had been experiencing pains similar to expelling pains, which became more serious on the night of Saturday, 17 May, and a large tumour protruded through the vagina. It was about the size of a calf's heart, fibrous in texture, quite vascular, and attached to the uterus by a long, thick pedicle. At this time, the patient lost three pounds of blood. Dr. Guardian was called, and sent for Dr. Lever. Upon arrival, he applied a ligature to the part of the tumour outside the vulva, and recommended that the patient be brought to Guy's hospital as soon as she was fit.

Upon her admission, she was very pale, in an extreme state of prostration, with a weak and frequent pulse, a thick tongue and barely any appetite. A Goork canal was applied to the vagina; the tumour was ligated higher than the first time. On the 21st, she vomited continuously and appeared weak and depressed; the losses from the tumour were excessive. As a result, it was incised at the site of the first ligature, leaving the cannula attached. From that day until the 30th, she seemed to lose consciousness, vomited a lot, and hardly took any food by mouth; twice a day he was injected with tea, beef and veal broth, and Oporto wine; the pulse was very weak, oscillating, between 80 and 110.

On the 30th, the ligature fell; the patient spent a very bad night. Dr. Lever called Mr. Bryant for a consultation. The transfusion was decided upon and carried out by the ordinary apparatus; the blood was provided by one of the students. About six ounces were injected, and several times during the operation, the patient was given small amounts of wine. Her pulse, which before the operation was between 120 and 135, fell to 90, and became much stronger. This woman fell asleep after the operation and had a very good night. Since then, her health has gradually improved. For the next four days she felt no pain and even took some light food in small quantities. On the evening of the fourth day, her strength weakened, and she died the next day at two o'clock in the afternoon.

Autopsy: All tissues and organs were found to be completely anaemic and loaded with fat. The peritoneum, on the surface of the intestines, in the vicinity of the pelvis, *was inflamed; the pelvic tissues, as well as the bladder and uterus, were in superation*; the liver had increased in size and was loaded with fat; the *kidneys were swollen* and there were lumps of pus in the external iliac vein. (*Moniteur des hôpitaux*, p. 653, 1857)

Reflections: By carefully reading of this observation and thinking about the death that followed the transfusion, is it possible to see a cause and effect relationship between the outcome of the disease and the operation performed? Those who are opposed to transfusion would not fail to reason in this way, if the cadaveric examination had not been done. But peritonitis, suppuration of the bladder, uterus, kidneys and the presence of pus in the outer iliac vein, are more than sufficient to explain the death. The transfusion appeared, on the contrary, to have altered the patient's condition in an advantageous manner, for during the four days that followed she was able to take food and the pulse was raised. This change was only to be temporary, because the transfusion of blood could not prevent the serious inflammatory accidents that the autopsy revealed existed.

33rd OBSERVATION

Uterine haemorrhage; transfusion; healing, by Dr. Douglas Fox

A thirty-year-old woman gave birth around the sixth month of her pregnancy. The expulsion of the fetus was followed by a violent haemorrhage. When Mr. Douglas Fox saw the patient, she was in a state of extreme exhaustion, almost unconscious and without a pulse, to the point that there were no other ways to save her than by transfusion. He passed about a glass of blood from the veins of one of the assistants into those of this lady, and soon made sure that the pulse began to be felt. After a few minutes, the patient managed to move without much difficulty, spoke distinctly and easily swallowed the medicines presented to her. The improvement was obvious; in short, ten minutes had barely elapsed when the circulation had recovered to such an extent that healing seemed assured. It did not wait long. (*New Medical Library*, t. III, p. 426, 1827)

34th OBSERVATION
Postpartum uterine haemorrhage; transfusion; healing, by Dr. Blundell

A woman was reduced to any extremity by postpartum uterine haemorrhage. For six hours the haemorrhage had been stopped, and despite the most violent stimulants, the patient did not revive. Blundell injected, in ten minutes, fourteen ounces of blood provided by the assistants. The pulse, eye, heat and colour of the skin immediately revived, and the patient said she was already feeling strong. (*The Lancet*, t. IX, p. 345. – *Archives*, 1852, p. 335)

35th OBSERVATION
Metrorrhagia; transfusion; healing, by Dr. Blundell

A middle-aged lady was seized, following childbirth, with such a haemorrhage that she was pale, cold, without strength; pulse at 130 was small, concentrated; in short, the patient was in the greatest danger. Blundell injected her with six ounces of blood, provided by his pupil Wright. The face immediately became calm, and strength reappeared a little. After a relapse two hours later, he injected six ounces of blood, provided by his other student Urvin. The pulse fell to 110, the strength returned, and soon the recovery was complete, despite an inflammation of the injured vein, which required the application of a few leeches. (*The Lancet*, t. X, p. 205. – *Archives*, 1852, p. 335)

36th and 37th OBSERVATIONS
Metrorrhagia; transfusion; healing, by Dr. Schraegle

Dr. Schraegle performed transfusion twice in two cases of metrorrhagia. The patients recovered. (Carre, *Thèses de Paris*, 1844, N° 214, p. 19)

38th OBSERVATION
Uterine haemorrhage; transfusion; healing, by Dr. Béry

Béry performed a transfusion for a uterine haemorrhage which was becoming very disturbing. Two and a half ounces of blood were injected very carefully. The effect was very happy for the patient, who was perfectly cured a month later. (Carre, *Thèses de Paris*, 1844, N° 214)

39th OBSERVATION

Metrorrhagia; transfusion; healing, by Professor Martin (1862)

A young primiparous woman experiences moderate uterine loss at the beginning of labour as a result of a sleigh ride. Professor Martin, called in, finds her cold, pale, the pulse was almost 108; the waters had gone; the bottom of the uterus greatly distended; the blood the flowed was serous and lump-free. Excessive anaemia and prostration, out of proportion to the blood lost to the outside, suggest an internal haemorrhage, by detachment of the placenta. The narrowness and rigidity of the cervix does not allow the extraction of fetus, the tampon is applied and the patient is revived by ordinary means. But the uterus grows disproportionately; exhaustion increases; fainting is increasing; the pulse stops from time to time; everything indicates that the haemorrhage continues and necessitates more effective relief. The version seems perilous, and Professor Martin decides to resort to blood transfusion. He performs it immediately, four different times and at short intervals. He injects a total of one hundred and eighty to two hundred grams of blood, supplied at the same time by a robust man. Soon the heat reappears, the cheeks colour a little, the pains are awakened, and the patient can support them. The tampon is removed; the uterine orifice is dilated enough to allow the fetus to be extracted with forceps. Immediately, clumps of blood weighing about two pounds escape; but soon a new haemorrhage occurs, which is stopped with injections of acidic water and a solution of iron percloride; nevertheless, the patient, exhausted, seemed on the point of expiring. Stronger stimulants had no effect. It was then that Professor Martin performed a second transfusion of about ninety grams of blood. The effect was wonderful. The patient was gradually coming to life, complaining only of a very ardent thirst. The childbirth was normal. After a fortnight the patient leaves the bed, still pale and weak, but on the way to a perfect recovery.

40th OBSERVATION

Metrorrhagia; transfusion; healing, by Dr. Weickert, of Freiberg, Saxony (1862)

A forty-three-year-old woman was in her eleventh delivery, when she suffered a haemorrhage that soon exhausted her. All the usual necessary means in such cases had been used; she experienced syncope that followed one another at increasingly short intervals. Already, the extremities were cold, the heartbeat and pulse barely perceptible; the eyes had lost their lustre. Everything, in a word, revealed the imminence of death. In this state, Mr. Weickert seeing no chance of salvation except a transfusion, decided to perform this operation.

Mr. Weickert used Martin's apparatus; he strictly observed all the precautions recommended by the latter. Nevertheless, he encountered unforeseen difficulties.

It is one of the children of the patient, a robust boy of seventeen, who provides the blood needed for transfusion.

Eager, above all, to prevent the clotting of the liquid, Mr. Weickert had the idea of letting out, each time from the vein, only the amount of blood strictly necessary to fill the syringe; but after two or three of these little bloodlettings, the young man was seized with syncope, and it was necessary to have recourse to complete the operation, to the dedication of a woman of vigorous appearance, who consented to be bled. The patient thus received blood from *two different individuals* in her veins, an unusual circumstance that extended the duration of the operation well beyond the usual time.

The most serious obstacle the operator had to contend with was rapid blood clotting of the blood. Not only did the liquid partially solidify in the syringe before the piston stroke was completed, but it was already beginning to coagulate in the vessel where it was received as it left the vein.

Finally, Mr. Weickert points out one last peculiarity which further contributed to prolonging and complicating the operation. The left median vein which had been used for the injection of blood had been exposed in the extent of half an inch, and throughout this extent it had been stripped of the sheath of connective tissue. A trocar, an opening had been made through which the cannula conducting the liquid had been introduced. Things were thus arranged, the operator was about to start the operation again, when the patient made a sudden movement that moved the cannula. To avoid the recurrence of this accident, he discovered and distinguished the vein to a larger extent; he lifted it with a thread; and each time the blood injection was interrupted, an aid tightened the thread loop so as to apply the vessel walls to the cannula; there was, however, no trace of phlebitis. Finally, despite these difficulties and complications, the success of the operation was nonetheless complete. (Extract of the *Gazette hebdomadaire, Gazette des hôpitaux*, August 9, 1862)

41st OBSERVATION

Metrorrhagia; transfusion; healing, by Dr. Thorne (1863)

On 11 January, Mr. Thorne, an obstetric clinic assistant at St. Bartholomew's Hospital in London, was called to see a woman who had just given birth to a seven-month-old fetus, which had died a long time ago. Within minutes, a severe haemorrhage appeared. Mr. Thorne moved the still-adherent placenta with his hand, made the tamponade, and the haemorrhage ceased; but the patient had remained almost without a pulse and extremely pale, symptoms evidently resulting from excessive blood loss. A mixture of cold water and brandy was administered, which stopped the vomiting; the position was going to get worse; twice even the breathing stopped, and it had to be artificially restored. The administration of an enema of half a pint of hot water with the addition of brandy had no effect, and it was clear that the patient would succumb. The transfusion was then made by Mr. Vernou, a surgeon at the hospital. However, both because a certain amount of blood was lost and as a result of the fainting of the young woman who supplied it, scarcely more than *two ounces were injected* into the median cephalic vein. This, however, seemed sufficient to stimulate the action of the heart ready to die out; for shortly afterwards, the pulsations of this organ and of arteries, which had become excessively weak, were sensibly raised. Enemas consisting of tea, beef and brandy were then given; the recovery was complete. (*Therapeutic Bulletin*, March 1853)

42nd OBSERVATION

Metrorrhagia; transfusion; healing, by Dr. Dutems

Séverine Culpin, the wife of Vatin, who lives in the village of Fayet, near Saint Quentin, is forty years old and a mother of seven children. Gifted with a good constitution, although of a lymphatic temperament, she had, from the time of her first menstruation at the age of sixteen, until recently, not experienced any disturbance with the functions of her uterus.

Married at the age of twenty, she became pregnant immediately, and since then she has only lost blood during childbirth. Her children were not born, however, at a shorter interval of two years from each other, but the prolonged breastfeeding to which she was submitted, and as a mother and as a nurse, made her become pregnant before the period returned.

In the course of 1857, her last infant delivered, menstruation reappeared and was accomplished regularly every three weeks, until the end of March 1858.

Menstruation had been lacking for four months, when on 18 August, a sudden and profuse flow of blood appeared without a known cause.

This loss frightened the patient, who condemned herself to rest for a day; but soon, resuming the care of her household, the blood began to flow again, but in moderation, until Sunday the 22nd, when the liquid escaped in greater quantity.

Every day of the following week was marked by a notable metrorrhagia. The patient sees her strength being exhausted, and the blood flow, far from ceasing, redoubled in violence on Sunday the 29th. The loss was so great that day, that this woman had several syncopes. These accidents were repeated and persisted into the night; at about two o'clock, following a very prolonged lipothymia, a convulsive attack occurred so violent that the husband thought he was losing his wife. From that moment vomiting occurred, frequent enough to throw the patient into the greatest prostration.

Summoned at four o'clock in the morning, I hurriedly went to this woman; I was frightened by the spectacle that I saw. The amount of blood lost was so great that all the bedding was soaked through. The assistants had not dared to move the patient, lest she might breathe her last in their hands. The face was seized up and extremely pale, showing complete exhaustion. By touching it, I noticed a tumefaction of the lips of the cervix between which was engaged a flattened clot, which I was careful not to shake.

Despite this obstacle, the haemorrhage continued. I prescribed a tonic potion designed to raise the strength of the patient and which had to be taken alternately with a mixture of ergotine (2 grams per 125 grams of distilled water). At the same time, I recommended combating vomiting by administering small pieces of ice. I also raised the patient's seat with oat-ball cushions, and applied an ice-filled bladder to the hypogastrium. Unfortunately, when I returned at four o'clock in the evening, I learned that the drugs had been rejected as soon as they were swallowed, and that, as a result of the tremors of the incessant vomiting, the blood loss had continued.

The patient’s sagging features, which gave her face a cadaveric appearance, the cooling of the extremities, the disappearance of the radial pulse, the very faint sound of the heartbeats, which resembled a kind of trembling, all made me predict an imminent end. In the face of similar symptoms, I saw no resource except a blood transfusion.

I hurried back to Saint-Quentin, in order to provide myself with the necessary instruments to perform this operation and to enlist the help of a colleague. The two doctors I went to were absent, and the patient was in urgent danger, so I had to return to her and resign myself to acting alone.

I began my operation by applying a ligature to the patient's arms, as if for a bloodletting; I then repressed the little blood contained in the veins, in order to be able to choose the largest vessel: it was the cephalic vein of the right arm. I laid it bare through an incision parallel to the axis of the vessel and isolated it in an expanse of one centimetre.

The individual who generously gave me the blood for this transfusion is a man aged forty-five, enjoying excellent health. The liquid was collected in a hydrocele syringe, whose tin body was surrounded by cloths soaked in hot water.

During this time, I made a longitudinal incision on the exposed vein of the patient. The syringe filled completely, so as to be able to reject from its contents the little frothy floating blood; I placed the double parachute piston. The instrument closed and letting the shining blood spurt out, the cloths soaked with hot water were changed. To facilitate the introduction of the cannula, I parted the lips of the wound with dissection forceps and the blunt and curved end of a silver stylet. With the cannula inserted, I slowly pushed the piston of the instrument.

My operation almost completed when the patient, who was remained completely motionless throughout the duration of the incisions, as a result of the insensitivity in which she was immersed, was seized with a convulsive attack which I thought was

fatal, as it was so violent. The crisis lasted only a minute, and caused me a moment of cruel anguish. But finally the inhalation of vinegar vapours and vigorous rubbing of the limbs soothed these frightening symptoms. The patient gradually regained her senses, cast astonished glances, and was soon able to express how she was feeling; it was a feeling of well-being. She appeared to be coming back to life after a long-lasting syncope.

The seizure I had just witnessed made we want to continue the injection: two-thirds of the blood in the syringe had penetrated(1), and although the patient's voice was still very weak, the improvement was so noticeable that I did not think it was prudent to expose her to another chance of an accident.

In a few moments, moreover, there was an unexpected reaction; the pulse, which had ceased to be appreciable, reappeared and marked 124 beats; the heartbeats, which resembled a kind of trepidation, regained their strength and sharpness, without being accompanied by any abnormal noise.

Reassured about the fate of my patient, I made her take two spoonfuls of her tonic potion: they were well tolerated. The strength gradually recovered under the influence of an analeptic regime, and on the fourth day the patient could be lifted to have her bed made; at the end of the week, I allowed her to walk with the assistance of her husband's arm. On September 11, she was walking alone in her garden, and she soon took care of her household. Ms. Vatin's health is now as robust as it was a year ago. (*Bulletin de Thérapeutique*, t. LVI, p. 85)

(1) The full syringe contained 180 grams of blood; the amount of liquid left in the instrument after the operation was barely 60 grams, so the patient had therefore received 120 grams.

Reflections: In this case, as in all the preceding ones, Mr. Dutems points out that the amount of blood injected was small (120 grams). But there is a peculiarity that manifested itself during the transfusion; I mean *the convulsive attack that the patient experienced*. Mr Dutems wondered whether, despite the care had taken to purge the blood of the air it contained, a few bubbles of this gas did enter the vessels; or if, just as the last phenomena that preceded the syncope were convulsive movements could not the first manifestations of return to life have been an attack of eclampsia? I am inclined to think that syncope was determined by the entry of air into the veins; and if death did not happen, it is because this gas only penetrated in small quantities. My experiences, reported in the third part of this work, can leave no doubt in this regard.

43rd OBSERVATION

Marie W..., thirty years old, six children, no syphilitic background, gave birth on 4 December 1862, very naturally. Immediately after the expulsion of the child, a flood of blood escapes from the uterus; a stimulating potion is given to the patient; it is recognized that the placenta has contracted numerous adhesions, and Dr. Hicks is called to the patient. Mr. Hicks detaches the placenta with great difficulty, and finds large albuminoid plaques on the inner surface of the uterus. Immediately after the operation, the haemorrhage had ceased and the uterus had become contractile again, but the pulse dropped visibly; it soon became imperceptible, and the patient fell into complete collapse. On three different occasions, Mr. Hicks injected six ounces of blood taken from the patient's husband, who himself fell into syncope, so that the operation was suspended. The operation seems to bring a good result. After a few moments, the pulse seems to go up; however, the patient succumbed two hours after her delivery.

44th OBSERVATION

Mr. Hicks reports a second transfusion attempt by him on a 38-year-old woman and mother of six children

The haemorrhage had occurred accidentally, and the child was full term. The patient's pulse is barely noticeable. Mr. Hicks performed the transfusion, and in the same condition as before. Six ounces of blood are introduced into the patient's veins; she was given stimulants in high doses: brandy, beef broth with tea. The pulse seems to come back, the patient speaks freely; the irons are applied without success.

Mr. Hicks then performs the reversal; the child is expelled, and it is noted that he has stopped living for a short time. The placenta is completely detached; cold water is injected into the uterus, which no longer contracts. Another transfusion attempt is unsuccessful. Died after a few minutes.

45th OBSERVATION

The third attempt at blood transfusion, reported by Mr. Greenholy and undertaken by him in the same circumstances, was successful

He is called to the patient, who has just given birth, after a seven-month pregnancy, to a dead fetus. According to the information she provides, the fetus died six weeks ago. Considerable haemorrhage. Mr. Greenholy detaches the placenta. The patient falls into the collapse. (Injection of brandy into the rectum, stimulating potion.) Mr. Greenholy introduces a few ounces of blood into the cephalic vein; the patient gets up; we feel the pulsations of the temporal artery, which had become imperceptible. During the six hours following the operation, injections of brandy and beef broth with tea into the rectum. Twelve hours later, the patient is better, the pulse is at 112, the tongue saburrale.

From the eleventh day, the patient was able to eat, and anaemia is the only symptom that still persists. (*The Lancet*, March 7, 1863. – The three previous observations are extracted from the *Gazette médicale de Lyon*, April 1, 1863, p. 158)

‘TABLE OF BLOOD TRANSFUSION IN CASES OF METRORRHAGIA’
This summary table, included in the original book (pages 85-85) has not been reproduced in this translation - PL

The preceding table contains the largest number of known cases of metrorrhagia treated by blood transfusion; there are 45 of them. Of these 45 incidents, it was performed 9 times for haemorrhages occurring at various times during pregnancy, 36 times to combat this incident, either during labour or after childbirth. The results obtained are as follows: 33 times the success was complete, and death occurred in 12 patients.

Should transfusion be considered the cause of these 12 failures?

Starting from the fact that it has always been used to oppose a fatal immediate termination caused by the considerable loss of blood, it is easy to convince ourselves that in 4 of the patients who died, the transfusion opposed the result.

We see, in fact, that death has happened:
1st on the *seventh day*, following a *uterine phlebitis* (Doctor May)
2nd on the *twenty-first day*, by a *metroperitonitis* (Professor Nelaton)

3rd on the *fifth day*, after a noticeable improvement in the patient's condition, as a result of *partial peritonitis*, *suppuration of the bladder, uterus, kidneys* and presence of pus in the external iliac vein (Lever and Bryant)
4th on the *seventh day*, the uterus being full of pus (Higginson)

In these 4 facts, after having escaped the dangers of haemorrhage by the use of this means, the patients succumbed to these accidents which are completely foreign to them, and which unfortunately tend to become too frequent complications of pregnancies.

If we add these 4 facts to the 33 already mentioned, the number of successes is increased to 37.

There are therefore 8 cases of death, coinciding with the use of transfusion; however, in 2, which lack details, *the delivery was not finished, the fetus was sill in the uterine cavity* when death occurred (Higginson).

In another case, the autopsy demonstrated that *air penetrated the veins* (Jewel and Boyle). Are we entitled to accuse the transfusion of blood as the cause of the final result, and is there not reason to wonder whether it was proper to employ it in the two cases reported by Higginson, and above all whether it was legitimate to expect some advantageous effect?

I am therefore entitled to conclude that it was in only 5 out of 45 cases that it was unable to oppose death. Is there, I ask, a single surgical operation of any importance, performed every day in hospitals, which yields similar results?

And, however, if one consults the writings of most contemporary surgeons, as I said at the beginning of this work, one sees transfusion judged as a useless method, often dangerous, and which has almost always given only failures; the birth attendants themselves do not mention it in their special treaties as a means of combating haemorrhages that occur during or after pregnancy. I have sought in vain for a simple indication of it in the works of Messrs. Chailly (Honoré), Jacquemier, Naegelé.

Cazeaux says: "The transfusion, so much praised by some English authors, in whose hands it seems to have succeeded on a number of occasions, has not had the same success in France. It is an extreme means, however, which could be used in a few desperate cases, but one that should not be relied upon too much; because the severity of the loss, the excessive weakness of the patient, and the slowness of the operation, often make it useless, not to mention the nervous and inflammatory accidents, the phlebitis, which often occur as a result of this operation." (*Traité d'accouchements,* 1850, 3rd edict., p. 971)

If Cazeaux had taken the care to study the matter before judging it, he would never have written these lines; on the contrary, he could have been convinced that, despite the seriousness of the loss, the excessive weakness of the patients, the slowness of the operation, the transfusion was performed 45 times, when all conventional means had been unnecessarily employed, and that 37 times it saved women condemned to certain death; he could have convinced himself, moreover, that the nervous and inflammatory accidents he is concerned with are purely imaginary, for *phlebitis has been noted once or twice*, and to such a degree that it yielded to the simplest anti-inflammatory medication. From all this, there is a lesson that cannot be avoided: it is that, while respecting men, even considering them for their personal worth, by bowing to the authority of their word which important works often make legitimate, opinions and theories should be accepted only when they are based on accurate facts and have been subjected to serious scrutiny.

I always thought that swearing on the master's word was to sanction the principle of immobility.

The careful reading of the many observations that I have just reported, and in which *the result has almost always been successful*, leaves no room for an objection that some however will not fail to make. It may be said that *all the failures have not*

been published, if one considers that the transfusion was only used only when all the known means had been *unsuccessfully employed, that a few ounces of blood injected into the veins* were always consistently sufficient to make reappear after a few moments the beating of the pulse and of the heart ready to die out, respiratory movements, intelligence and life, we will understand that it must have always been so, and that therefore it is impossible to admit that the number of setbacks was greater than that I have just mentioned. Besides, why are they silent? Could it be the feeling of fear that would stop the doctor and prevent him from making them known? But the conditions under which this operation is carried out, legitimizes its use too much for a surgeon to ever think of keeping silent on the unfortunate results it would have brought. Do amputations, resections, disarticulations, tracheotomy used to fight croup, in short, all major surgical operations, give rise only to successes? Do we hesitate to publish them when they have not been successful in their consequences? Why should blood transfusion not enjoy the same privilege?

This objection, if it were formulated, would therefore not be serious, and I believe myself entitled to conclude facts that I have just reported:

That blood transfusion is one of the most powerful and effective means that the surgeon has to combat the serious, hopeless haemorrhages that occur during pregnancy and after childbirth.

SECOND GROUP
Blood transfusion performed in cases of traumatic haemorrhages

1st OBSERVATION
Transfusion performed in a case of complicated fracture of the leg; momentary success; death, by Mr. Ant. Danyau (1829)

In November 1829 a man presented at St. Thomas's Hospital in London, with a broken leg complicated by a wound and a portion of the bone emerging. For ten days, the patient had been fine. At that time, considerable haemorrhage occurred; they decided on amputation; but the patient was so weak that it was feared that he would die during the operation. *Eight ounces of blood were slowly and carefully injected; the patient was in a satisfactory state* and the amputation was performed. The next day, the patient was well; the day after, the weakness was so great that it was felt necessary to perform a third transfusion; another eight ounces of blood were injected, but the patient was no better and died the next night. The autopsy could not be done, and the surface of the stump was gangrenous. (*Revue de Paris*, 1851)

This observation is interesting in more ways than one. If the transfusion could not save the patient, far from being harmful to him, it was, on the contrary, useful to him; it first allowed the amputation to be performed that the state of extreme weakness prevented; in addition, a momentary improvement was the result. If the patient has succumbed, it is not attributable to the transfusion, but to the danger of immediate amputations, to suppuration, to gangrene of the stump, to putrid infection perhaps, circumstances that so often compromise the outcome of amputations in hospitals.

2nd OBSERVATION
Transfusion performed in a case of injury to the subclavian artery; death, by Professor Roux (1830)

A young fighter of the July Revolution received a bullet in the subclavicular region that opened the subclavian artery. Slow and repeated haemorrhages eventually compromised its existence; he was almost dying when Mr. Roux resorted to transfusion. *Fourteen ounces of blood were injected in one go; the patient died instantly*. The autopsy showed that the heart was in an apoplectic state; it was filled with coagulated blood, as well as the afferent vessels. *Everyone at the operation and at the opening of the corpse remained convinced that too large a quantity of blood had been injected*. (Rognetta*, Bulletin thérapeutique,* t. X, p. 214)

I do not think there is any point in adding anything to the foregoing reflection and to the judgment expressed by those who attended the autopsy, to demonstrate that in this case the transfusion is completely unrelated to death.

3rd OBSERVATION
Neck tumour; ablation; haemorrhage; transfusion; death, by Dr. Scott (1833)

In 1833, a fourteen-year-old girl entered the London Hospital, with a large tumour on her neck, occupying the entire subclavicular triangle, and even extending under the sternomastoid. During the operation Scott opened the jugular: a considerable haemorrhage set in before he could tie the two ends of the vessel; the patient, almost dead, was carried to a warm bed, and an injection of eight to ten ounces of blood was made into the four veins of the arm; brandy and water were injected into the anus, but the young girl died less than three-quarters of an hour after the operation. (*Lancette française,* 1833, p. 519)

Are we not entitled to make, in the manner in which the transfusion was carried out in this case, the same reproach that was made to Mr. Roux's observation? Wasn't ten ounces of blood put into the veins of a fourteen-year-old girl at one time an exaggerated dose? Secondly, the tumour was located in the subclavicular region, and the jugular having been opened at the point where the venous pulse is made, are we not entitled to think that air was introduced spontaneously by opening the vein during the aspiration of the chest, and that this accident may have contributed to so rapid fatal termination?

4th OBSERVATION
Transfusion successfully performed for a constitutional haemorrhage following strabismus surgery, by Dr. Samuel Lane (1839)

Eleven-year-old George Firmin, was brought to Mr. Lane, by his father for surgery for convergent strabismus. The operation was performed by incision of the conjunctiva, according to the procedure indicated by Stromeyer. The internal right muscle was cut, and nothing special was observed except that syncope occurred and the flow of blood through the small wound of the conjunctiva was more abundant than usual. However, this haemorrhage was not immediately follow, and the child was able to walk soon after. On the evening of the same day, the haemorrhage reappeared, and the discharge lasted several hours. However, the surgeon still managed to master it, after having exerted compression for about half an hour. The parents *then told Mr. Lane that the child had repeatedly experienced severe haemorrhages after small wounds and that his life had even been compromised*. It had been about four years since the avulsion of a tooth had resulted in haemorrhage for four days, and had even necessitated his admission to Guy's Hospital. Three months later, he had been placed in the same facility for another haemorrhage, which had resisted all

haemostatic means for fifteen days. A few months later, a new haemorrhage had appeared after a small cut to the finger; but it had given way to compression.

In September 1839, an application of leaches to the knee had produced a new haemorrhage that resisted all means, and yielded only to the carefully performed suture on each puncture.

To return to the current accident, the blood stopped every time the injured child got up, or when syncope occurred; but as soon as the circulation was revived a little, and the pulsations of the radial artery began to be perceived, the flow reappeared. The blood, carefully examined, appeared liquid, as if it had been diluted with water; it was not very plastic, and difficult to coagulate. By the third day, the haemorrhage was moderated by dabbing the orbit with a little tragacanth powder on which the compression was performed; the child also held the device with his hand. However, the slightest movement in this point caused the flow of blood to reappear.

Day four: The young Firmin vomits everything he is made to take; prostration is extreme, and yet haemorrhage continues with abundance; it is feared that the patient will expire.

Day five: Syncope is more frequent and protracted; the child experiences convulsive movements. Stomach contractions occur; the patient is threatened with suffocation, the skin is cold and discoloured, the pulse is imperceptible to the arteries of the forearm, the prostration is complete. Mr. Lane offers the transfusion.

Day six: The transfusion is performed at seven o'clock in the evening, in the presence of Mr. Philips and several other doctors.

Mr. Lane then dissected one of the veins at the crease of the arm; he passes an Anel stylus under it; the syringe cannula is placed in an opening made in the dissected vessel, and it is ensured that the manoeuvre will be easy. Mr. Ancell bled a robust young woman who offered himself. The funnel received two ounces of blood, and part of it was left to flow into the syringe, and it was ready to be injected into the vein, after have carefully expelled the air; but the blood began to clot; the device was then removed and dipped in hot water, and after having taken this precaution, the blood was gently removed as it fell directly from the funnel into the syringe, being care to watch the state of respiration and brain functions, as well as the movements of the ribs and the coloration of the various regions, at each piston stroke. Five and a half ounces of blood was injected in four times, taking a precaution however, to leave a moment’s interval in each injection; we then stopped. *The first result was the manifestation of the pulse to the radial artery*. Two hours later the improvement was great; the child had regained consciousness; he was able to sit up and drink a glass of water and wine. The haemorrhage did not reappear; in a short time the appetite manifested itself, the strength increased, and the healing was perfect after three weeks. Since then, well-being has persisted, and strabismus has also healed. (*The Lancet*, Oct. 1840 – *Arch. de Méd.*, 3 series, p. 234, t. X, 1841)

Reflections: In his Treatise on Internal Pathology and Therapy, which is and undoubtedly will be one of the finest books in medical literature in the 19th century, Mr. Gintrac devoted a long chapter to the study of haemorrhagic diathesis or haemophilia. After carefully recounting all the observations that legitimize the existence of this diathesis, including that of Samuel Lane which I have just mentioned in detail, Mr. Gintrac deals with issues relating to the pathological causes, general phenomena, diagnosis, pathological anatomy and physiology of haemophilia. When he arrives at the prognosis, he expresses himself as follows:

"The constitutional provision in question is always very unfortunate. It is more so if it is obviously hereditary and if haemorrhages have started early and follow one another frequently; if the subject is very weak, if the flow of the blood seems to be mainly passive, if art is powerless to block it. It is rare that the sick do not succumb

while still young. When they resist, the danger seems to recede, haemorrhages become rarer as they advance." (Volume III, p. 127)

The careful reading of Samuel Lane's observation cannot leave any doubt as to the existence of haemorrhagic diathesis in the young child to whom he performed the strabismus operation; but it also demonstrates what indisputable service the transfusion rendered to this patient, since it prevented death, which was imminent, as a result of the abundant losses of blood, repetitive syncope and extreme prostration. Finally, it authorizes me to raise this question, which later observations alone can shed light on: Is not transfusion the most powerful means to oppose haemorrhagic diathesis, and the introduction of foreign blood into the veins of a person subjected to this particular predisposition, brings about changes in the body that result in the removing it from the fatal consequences of this diathesis?

5th OBSERVATION
Transfusion in a case of haemorrhage occurring as a result of amputation of the thigh; healing, by Dr. Furner (1844)

A thirty-seven year old woman had her thigh amputated for knee cancer. A considerable haemorrhage occurred, the pulse had become imperceptible, the collapse was general, the syncopal state almost complete. Five ounces of blood were transfused; the success of the operation was immediate; the skin became warm again, and the patient recovered. (Th. de Paris, 1844, N° 214, p. 19. Carré)

6th OBSERVATION
Blood transfusion made for a saphenous haemorrhage following exertion; healing, by Dr Sacristan (1851)

A twenty-six-year-old woman, six and a half months pregnant, affected with varicose veins, made an effort that determined a tear in the saphenous vein; a haemorrhage occurred that soon produced such a syncope that the patient was without a pulse and there was only a few dull beats in the precordial region. After trying to revive her by approaching ammonia in its nostrils and applying repercussions to her stomach, Mr. Sacristan proposed and performed the transfusion; he opened a vein in her arm and injected six ounces of blood. Two minutes later, the patient began to be agitated; she opened her eyes, and felt the urge to vomit. The pulse began to beat. Six hours later, we could count the beats (109 per minute); the patient answered questions, and the heat returned. In the night there was an abortion; the fetus was dead and rotten. A moment later, it was believed that she would not succumb to this serious complication. Nevertheless, she regained her strength; on the seventh day she was taking food; and although recovery was interrupted by a violent fever caused by carelessness, one month after the operation, recovery was complete.

7th OBSERVATION
Transfusion performed in a patient exhausted by a secondary haemorrhage following a phlegmon of the thigh; primitive success; died of pneumonia, by Dr. Simon

A forty-year-old man entered the wards of Dr. Simon on 6 March 1851 for a contused wound in his thigh, the result of an accident. Although the soft parts were deeply involved, Mr. Simon, finding the patient with appearances of robust health, wanted to try to save the limb. When suppuration was established, he was put on a fortifying diet; nevertheless abscesses formed, which were opened; suppuration occurred in

the cellular tissue and erysipelas; fistulous paths had opened, through which pus and shreds of mortified cell tissue escaped: one of these paths was located at the inner part of the thigh above the knee, the other outside.

On 9 April, a terrible haemorrhage suddenly occurred, for which femoral compression was immediately performed; this did not prevent Mr. Simon from arriving, he found the patient almost dying. Immediately thinking of the transfusion, he took advantage of the goodwill of a student, Mr. Chaldecotte, who gave his arm for a bloodletting, and sixteen ounces of blood were immediately injected into one of the veins of the arm. The effect of this injection was most remarkable; the patient is reborn. Nevertheless, Mr. Simon tied the femoral artery to the crease of the armpit, until he could perform thigh amputation. Against all odds, the stimulants and transfusion had revived this poor patient, to the point that Mr. Simon could perform amputation two days later. This operation was done after having put the patient to sleep and after having the soft parts compressed by aids, in order to avoid the loss of blood. It was recognized by examination of the limb that the inner wall of the artery had opened and had given out blood.

The patient had endured the operation very well, and everything went perfectly until 13 April, when the weakness became such, that Mr. Simon, who had already foreseen this eventuality, performed a new transfusion of the blood, but without success; death occurred on the same day, fourteen hours after the second transfusion.

The autopsy showed that the lungs were inflamed in a large area, and their tissue softened and crumbly. (*Union médicale,* 26 April 1851)

The good immediate effects of transfusion are indisputable in Mr. Simon's observation; death did not in fact happen until the fifth day, and while the introduction of blood into the vessels had revived life and allowed amputation. The patient succumbed to extensive pneumonia that caused the softening and friability of the lung tissue. One might perhaps be entitled to wonder whether the injection of sixteen ounces of blood at once could not, to some extent, have contributed to the production of this lesion of the respiratory system! It should be noted, moreover, that the beneficial effects of transfusion are lasting only when the amounts of blood introduced at the same time are small; it is better to do several injections at fairly close intervals than to make a single one with too high a dose. The operation usually succeeds in these circumstances. In any event, in Mr. Simon's patient the transfusion was not without benefit.

8th OBSERVATION

Cancerous tumour of the maxillary region; surgery; transfusion; unsuccessful, by Dr. Maisonneuve

In May 1854, Mr. Maisonneuve was engaged to remove a tumour of the maxillary region, the right carotid, in a man. Some time later, a severe haemorrhage occurred, putting the patient's life in danger. Transfusion was used with the device of Mr. Mathieu, who was present, and in the presence of Messrs. Lucien, Boyer, Marc Sée. Mr. Maisonneuve took blood from a young and vigorous subject, and began the operation. The patient felt better at first, but he succumbed to the disease soon after. The amount of blood injected is not indicated, but it was considerable, since at the autopsy general symptoms of congestion were found.

9th OBSERVATION

Severe haemorrhage following excision of a nasopharyngeal polyp; prolonged syncope; use of blood transfusion and wine enemas; healing, by Dr. Michaux

A seventeen-year-old man had been carrying a nasopharyngeal fibrous polyp for three years. Often repeated and sometimes profuse haemorrhages, difficulty in breathing and swallowing, and some intercurrent illnesses, had greatly weakened our patient. He was very anaemic. I first tried the ligation of the polyp that was unsuccessful. After several explorations, I felt that this incident should be attacked by excision combined with a moderate tearing, having previously created a pathway through the moving veil and the vault of the palace (Mr. Nélaton's process). Every precaution had to be taken to prevent significant blood loss; the operation had to be done quickly; also, it was completed in three minutes.

The excision and tearing of the polyp were followed by a devastating haemorrhage; a stream of blood came out of the mouth. A white-hot cautery was extinguished on the insertion of the polyp. When I wanted to use a second cautery, I noticed the eyes were spinning in their orbit, and that my patient was sagging. Everyone present thought he was dying. I immediately inserted two fingers into the back of the mouth to compress the point from which the blood came out. I turned my head forward, and laid the patient on his stomach, his head on the slope. This position was to prevent blood from falling into the airways. Pellets soaked in iron-perchloride were successively placed and held with the fingers on the source of the haemorrhage. At the same time, I opened the windows of my amphitheatre; I threw cold water on the face, while my helpers breathed in ammonia and performed rubs with cinnamon dye, quinquina, and even with ammonia.

After using these means for a few minutes (12 to 15), the haemorrhage stopped completely, and the young man awoke a little. I took advantage of this moment to make him swallow three spoonfuls of wine in which we had placed cinnamon tincture. However, the pulse was barely noticeable and very irregular, the skin remained cold, eyes closed. The storm was far from over. I had him transported to the sloped bed that had been prepared for him in a private room to continue his care. Jugs filled with hot water were placed around the patient; sinapisms covered the surface of the body, Gondret's ointment applied to the precordial region, friction on the points not covered with sinapisms, were the exciting means to which we resorted. I had 30 drops of laudanum taken in cinnamon dye, a medium I saw used with great success by my colleague and friend Mr. Hubert in severe metrorrhagia.

Despite all these means, the young man remained cold, his pulse very small, his eyes closed, and the death rattle began. Transfusion was suggested. I immediately accepted this idea. A healthy nurse willingly donated blood. I uncovered the right median basilic vein, in which the veins of the fold of the arm were little developed. The nurse was bled; the blood was collected in a vessel immersed in hot water, and was taken by means of a small glass syringe to be gently injected into the vein of the patient, which I had opened longitudinally. Every precaution was taken to ensure that air was not introduced into the vein, either by injection or during the intervals of the injection; about 4 ounces of blood were injected. The patient appeared a little better after the transfusion, but the better was not marked. Finally, we ran three enemas of 4 to 5 ounces of regular wine and one ounce of alcohol. The stimulants on the skin surface were continued. I inserted a probe into the pharynx to swallow some wine and cinnamon tincture. The patient was often awakened to encourage him, to revive him and somehow warn him against death. Imperceptibly, life returned, and around three o'clock relief, we hoped to save the patient.

The operation had been performed around ten o'clock in the morning. The best continued; a gentle reaction set in; broth was given by the mouth and in enemas, etc.

It is now four days since the operation was carried out; no accident other than syncope has occurred.

The young man remained in hospital until 20 March. By that time, he had regained his strength, but he was still too weak to bear the surgery necessary to destroy the rest of the nasopharyngeal polyp. I sent my patient back to the country where he had to find good air to breathe and a good diet, for he did not belong to the

poor class of our land. I urged him to come back to us as soon as he had fully repaired the blood loss he had suffered.

The patient returned to the hospital on 20 October, and after several unsuccessful attempts, on 5 December I managed to completely remove the polyp by combining excision, tearing, roaring and cauterization. No accidents occurred as a result of this last operation, which I hope will result in a permanent cure. Over the past year, this patient has developed a lot. On 4 February 1860, after having explored the area occupied by the polyp and having found no appearance of morbid reproduction, I sent this young man back to his parents. (*Bulletin de Thérapeutique,* t. LVIII, p. 162. 1860)

10th OBSERVATION

Blood transfusion; healing

Dr. Higginson reports, in the midst of a discussion on the treatment of arterial wounds, the following fact:

J. C..., fifty-one years old, shipwright, entered the South Liverpool hospital (May 1860). Inflammation of the anterior face of the left forearm.

On the 15th, incision of infiltrated tissues; suppuration is established, mortification of the parts. Beforehand, there had been two haemorrhages; later, a third. Ligature of the humeral at the crease of the arm; haemorrhage stops, but the condition of the limb becomes severe and requires amputation. However, general weakness is at odds with this operation. Transfusion decided. Higginson injects three hundred and sixty grams of blood into the veins of the healthy forearms. Immediate improvement. The next day, June 18, amputation. On the 24th, legs and left aisle swell, purple colour. The circulation of blood appeared to be intercepted, but this condition dissipated under the influence of greasy frictions and a milky and alcoholic diet. The cured patient leaves the hospital three months after admission. (*Liverpool Medical Institution*, February 6, 1863 – *Gazette*, Lyon, March 16, 1863)

‘TABLE OF BLOOD TRANSFUSION IN CASES OF TRAUMATIC HAEMORRHAGE’

This summary table, included in the original book (page 100) has not been reproduced in this translation - PL

It follows from the examination of this table that, in 10 cases of blood transfusion for traumatic haemorrhage, complete success was achieved 5 times: twice it remedied the haemorrhage accidents by bringing back to life patients who later died, one from amputation (suppuration and gangrene of the stump), and the other from very extensive pneumonia.

The autopsy of two patients, among the 3 who died, proved that death was the result, not of the transfusion, but of the manner in which it had been performed and of the too great amount of blood injected into the veins at once. The cadaveric examination of the little girl treated by Scott was not done, but all indications suggest that there was an introduction of air into the vessels.

As can be seen, in traumatic haemorrhages as in metrorrhagia, the transfusion of blood has truly rendered service to the patients.

THIRD GROUP
Blood transfusion performed in cases of anaemia by various causes

1st OBSERVATION
Blood transfusion in a case of emaciation; success, by Dr. Clark (1843)

The subject of this observation is a trader who used to travel for the business of his trade; he had been vigorous and active, and had led the life of the people of his profession, however with a little more sobriety. When Dr. Clark first saw him on 11 January 1843, he had grown weak and sick for two years; he had begun to experience symptoms of dyspepsia, which were soon followed by debility and emaciation, and had reached the last degree of decline. His pulse was trembling and barely sensitive; the slightest movement caused palpitations that went as far as syncope. However, the chest organs showed no physically appreciable pain. At the bottom of the vessel was abundant whitish sediment, which reddened slightly and disappeared with the addition of an alkali diluted with water. It was agreed, in a consultation with doctors, to resort to a fortifying diet.

Unfortunately, the stomach only supported food in small amounts, and even ended up not supporting it at all; we feared at every moment a fatal syncope. In this extremity, it was resolved to try the effects of blood transfusion.

Sixteen ounces of blood were provided by a healthy and vigorous young man, the patient's domestic servant, and were injected into the patient's veins by Mr. Clark, with all desirable skill. *Life reappeared instantly on the patient's features*. The next day he was much stronger; he even complained of a feeling of heaviness in his head. A few drops of blood escaped from his nostrils from time to time. These minor incidents soon dissipated; appetite soon returned, strength gradually reappeared, the urine acquired a better appearance under the influence of alkaline drinks, iron water and a few bottles of an iron citrate solution. After two or three months of treatment, the patient was able to return to his usual profession, which he still practices today. (*Annales de la Chirurgie française,* February 1844. – *Bulletin de Thérapeutique,* t. XXVI, p. 239. 1844)

2nd OBSERVATION
Weakening occurring as a result of successive bleedings; transfusion with lamb's blood, healing, by Denis (1665)

A young man of sixteen, who, following a fever that lasted two months in which he had been bled twenty times, had remained in a stupor and drowsiness. Denis drew three ounces of blood and transfused nine ounces of arterial lamb's blood into him. The young boy lost three or four drops of blood from his nose, and then became calm again. His sleep ceased to be restless; he gained more strength and acquired more strength agility in the limbs, became overweight, and always got better and better until complete recovery. (*Journal des Savants*, already quoted)

3rd OBSERVATION

In a book entitled '*De Nova et inaudita medico chirurgico operatione*', Rome 1668, Manfredi de Lucca recounts the observation of a very weak old man, to which he successfully performed transfusion with lamb's blood, through an intermediate cannula placed in the vein of the arm.

4th OBSERVATION
Multiple haemorrhages from the eyes, nose, mouth and stomach; transfusion; healing, by Drs. Uyterroheven and Bougard (1848)

A thirty-year-old woman, affected for four years with continuous haemorrhages by the eyes, nose, mouth, stomach, bronchi and genitals, the ear canal and breasts, who even had a kind of blood sweat, and who had been treated without success by an infinite number of means and by a considerable number of doctors, was subjected to transfusion by Messrs. Uyterroheven and Bougard; they first injected two and a half ounces of blood into the cephalic, which produced a feeling of warmth from the upper arm to the chest, dropped the pulse from 108 to 88, and brought great relief. Another injection of two ounces of blood. Gradual improvement. A third injection was even given, which was followed by a satisfactory condition. The patient was getting up, and she was already about to leave the hospital, when she was seized with a sever metrorrhagia following peritoneal suppuration, to which she succumbed four months after transfusion. (*Journal de Bruxelles,* 1848. – *Gazette médicale,* p. 132. 1850)

5th OBSERVATION
Blood transfusion in a case of anaemia; death, by Professor Monneret (1843)

A twenty-eight-year-old woman, who has been plagued since childhood by frequent and abundant haemorrhages that had recently been reduced to a simple vaginal oozing of blood, alternating with petechiae, was reduced to the most extreme state of anaemia when she entered hospital.

The patient's condition worsened day by the day, despite the use of tonic treatment, Mr. Monneret, after ensuring the integrity of the viscera, decided to perform the transfusion.

The operation was performed on 7 October; 120 grams of defibrinated blood was injected. The patient endured this operation well; she did not experience any particular sensation for the duration of the injection; the pulse had even risen. Nevertheless, a few hours later, there occurred a great restlessness with a burning thirst, soon followed by cooling of the extremities, gradual weakening, and the patient succumbed.

At the autopsy, various lesions were found, such as flaccidity, softness and pallor of almost all the mucous membranes, many petechiae on the surface of most organs, all of which belonged exclusively, according to Mr. Monneret, to the anaemia; he found no alteration that could be attributed to the transfusion. No internal haemorrhage had occurred, no fibrinous concretion had formed during life, neither in the heart nor in the large vessels. The blood, examined under a microscope during life and death, exhibited no special alteration, either in its blood cells or in the fibrin. (Acad. des Sciences, meeting 14 October 1851. – *Gazette médicale,* p. 644, 1851)

Mr. Monneret's reflections on the observation, which I have just reported, can be summarised as follows:

1. No cadaveric phenomenon could lead one to believe, on the first examination, that the transfusion had been the cause of death
2. He does not admit that the procedure used by him was defective, for he had been careful, and he insists very much on this point, to defibrinate the blood as Muller advises, as well as modern physiologists, Dieffenbach, Bischoff, Brown
3. In addition, he had injected 120 grams of blood.

Despite all this, the patient succumbed. He concludes with this reflection:

"What will always make blood transfusion an anti-physiological operation is not only because we introduce blood that has blood cells, fibrin, and probably other immediate principles are different, but because we add an elaborate, modified liquid prepared by an organism to another organism that does not resemble the other."

The answer to all these objections is very easy.

The details provided by Mr. Monneret demonstrate that the cadaveric examination did not reveal any lesions that could be attributed to the transfusion, while there were ones that the author himself regarded as the consequence of anaemia.

This is enough for us to free the transfusion from the fatal termination. When an alteration has occurred gradually through repeated successive haemorrhages, and for many years, and anaemia has reached the extreme, is it possible, is it rational to think that 120 grams of blood will quickly make such a disease disappear? How far is it from anaemia that results from an immediate loss of blood, although very considerable, to that which occurs slowly as a result of repeated small losses? Transfusion, done at the last limits of life, cannot be more successful than the other means used. Would it have been the same if, instead of waiting, multiple transfusions had been performed for a long time? I like to think not. What is important in a case like this is to find, at the autopsy, that if the transfusion did not prevent death, it did not at least cause it.

I will not seek to demonstrate that if there is a physiological operation, it is certainly transfusion; I will merely content myself with opposing this opinion of Mr. Monneret with the numerous facts of healing, of real resurrections carried out by it, and which are mentioned in the first part of this Memoir. Mr. Monneret replies, it is true, that it is not certain that, in all the cases where it took place, the healing was produced by the transfusion. If the surgeons called in from the patients who were transfused, had performed this operation first, Mr. Monneret might be allowed to express his doubts about the cause of success; but if we note all the Metrorrhagia observations, we will see that it is only after using all the conventional means usually employed that transfusion has been used as an extreme resource. The sick were saved; wasn't it the transfusion that cured them?

6th OBSERVATION

Chlorosis with cerebrospinal irritation; transfusion; healing, by Dr. Giovanni Polli (1851)

A young lady had been affected for several years by chlorosis with cerebrospinal irritation, for which she had been bled more than three hundred times; she had also been treated with quinquina, ferruginous, tonics, depuratives, narcotics, resolutives; she had been martyred in every way by repellents applied to all points of the body, and all this to no avail, since menstruation had become increasingly rare and difficult, especially in the last two years; languid digestion, imperfect nutrition, pale-yellow skin, almost icteric. The patient thus dragged on a painful existence, abandoned her bed from time to time, but only to be resumed a few days later from congestive irritations of the head or chest, which forced the doctors to deprive her again of what strength she had been able to gather.

For two weeks, the patient had been in bed with a dry and tiring cough, accompanied by fever in the evening. She had already been bled three times without any decrease in symptoms.

Mr. Giovanni Polli proposed the transfusion. Four ounces of blood defibrinated by beating was introduced through the right cephalic median vein. Soon after, three ounces were introduced again.

The day after the operation, the cough was gone. Three days later, she was able to get up; on the fourth day she left the room to go to a steamboat, on which she embarked on a pleasure trip.

The operation had been carried out on 20 October, and by the end of December Mr. G. Polli received a letter from this young lady, announcing that she was perfectly cured, and that menstruation, long suspended, had been re-establish; she did not hesitate to relate the cure to the transfusion. Mr. G. Polli even heard from her on February 15, 1852, and the cure had not denied. (*Archives de Médecine,* 1852, p. 342)

Is it possible, after reading this observation, to consider blood transfusion as an anti-physiological operation?

7th OBSERVATION

Extreme prostration caused by prolonged breastfeeding of two twins; transfusion; healing, by Dr. Higginson (1855)

The exhaustion was extreme; the patient fainted every time she lifted her head from the pillow; she was considered to have died in the night. The author injected twelve ounces of blood taken from a robust person; calm came, the pulse improved; the patient seemed to be sleeping, but a few minutes later there was a great stiffness, which fortunately did not last. The reaction took place, the patient sang a hymn aloud, and made a full recovery.

8th OBSERVATION

Mania, failure to take food, exhaustion; transfusion; death, by Dr. Higginson (1857)

The pulse had disappeared from the radial arteries; a woman provides a sufficient amount of blood; the pulse returned at intervals, breathing was better, and the physiognomy was better. Twenty ounces of blood at the most was injected. The next day, the patient looked better; but soon the symptoms worsened, and she died. The heart contained black blood. (The two previous observations can be found in the *Archives de Médecine*, 5th series, t. X, p. 346, 1857)

Mr. Neudefer has just performed new blood transfusion experiments at the San Spirito Hospital in Verona on the wounded of the Austrian army: the subjects were all in extremely desperate conditions; they were reduced to the last degree of collapse by endless suppurations as a result of gunshot wounds. Complete loss of appetite and sleep made recovery by ordinary dietary resources impossible.

The transfusion was attempted with all the necessary precautions; the blood was injected, defibrinated, and maintained at a suitable temperature; the quantity was no more than three or four ounces; the five subjects who underwent this operation showed a pleasant feeling of warmth, extending from the arm where the injection was being given to the chest. There was a clear improvement in their general condition; pulse was growing in size and strength; the patients enjoyed a restful sleep that the narcotic preparations had not been able to give them until then; the appetite was awakening. The improvement in the general condition persisted in all for five to eight days; it even lasted ten days, following the second transfusion, in a subject on whom this operation was repeated. But there the beneficent effect of the transfusion ended. From that moment on, the patients fell back into the desperate state that had motivated the therapeutic trial. Of the five operated on, four died after four weeks: the one who received two transfusions lived five weeks. With the lives of these

patients appearing to have been prolonged by at least a few days, Mr. Neudefer proposed to continue his experiments when a sixth patient died shortly after the operation.

This fatal result is reported by the author to the nature of the blood taken from a subject who was in the early stages of an attack of gout. Mr. Neudefer believes that the blood tainted by the diathesis of uric acid must have acted like a poison. (*Bulletin de Thérapeutique,* t. LIX, p. 578. 1860)

Of the five facts reported by Mr. Neudefer, there follows a great lesson: the patients had reached a state of extreme weakness, exhausted by abundant suppurations and reduced to the last degree of collapse; appetite was completely zero, and loss of sleep absolute. Under the influence of transfusion, sleep reappeared along with appetite, and the general condition improved significantly. This improvement was only temporary, it is true; but although transient, it was unquestionably the result of the transfusion. Therefore, is it not right to think that if it had been practiced earlier, at a time when life was less ready to die out, the improvement brought by it in the patient's condition, instead of being momentary, would have become definitive? Will it be necessary to wait until death is ready to arrive before resorting to use this operation in similar cases?

'TABLE OF BLOOD TRANSFUSION IN CASES OF ANAEMIA BY VARIOUS CAUSES'

This summary table, included in the original book (page 100) has not been reproduced in this translation - PL

FOURTH GROUP
Blood transfusion performed in cases of madness

The first observation of madness treated by the transfusion of blood is already known: it is that of Mauroy, whom Denys submitted to the use of this means. I have reported it in enough detail at the beginning of this Memoir to need only to recall it here. It is known that it was as a result of this operation that the Châtelet edict prohibited transfusion, despite the improvement produced by it, in the patient.

2nd OBSERVATION

Six-year-old madness following a violent moral emotion; transfusion; improvement, by Dr. Giovanni Polli

Mr. Giovanni Polli reports this observation in these terms:

On October 17, a young girl who was insane as a result of the deep pain caused by the loss of her mother, who also showed epileptic seizures, was subjected to transfusion. A bloodletting was performed on a forty-year-old woman, robust and affected by the onset of rheumatism. The blood, defibrinated by beating, was kept ready for injection. Giovanni Polli cut the middle vein of the *left arm* to an extent of about 5 to 6 millimetres, let out a few ounces of blood, filled a small syringe with defibrinated blood, and began the injection. He repeated this operation three times, leaving four minutes between each injection. Much of the blood flowed back, and no more than 7 to 8 grams of fluid entered the vessel. The patient showed no signs of sharp pain; she simply complained of a simple burning sensation, which went up the vein a few centimetres, and which lasted a few hours, a sensation that was to be related to the introduction of the cannula and the formation of a *thrombus*. The

wound was treated like any ordinary wound; and two days later, the patient was fully recovered from the local lesion.

On October 19, Mr. Polli uncovered the left median cephalic vein, and injected defibrinated blood at a temperature of 12° centigrade; he managed to get 12 grams of blood in. A notable improvement resulted from the operation. (*Arch. de Médec.*, 1852, p. 342 and follow)

FIFTH GROUP
Blood transfusion performed in cases of cancer

Transfusion in a case of pylorus cancer; death, by Blundell

In a man with *squirrhe* of the pylorus, and reduced by continuous vomiting to such an emaciation that he had the appearance of a skeleton, Blundell, after having resisted the patient's urges for a long time, eventually performed the transfusion. He introduced through the cephalic vein, and in an interval of forty minutes, 12 or 14 ounces of blood. A few hours later, the patient regained a better coloration, was able to move his limbs, and said that he felt much better and much less weak. The next day, prostration reappeared, vomiting and evacuations recurred, and death occurred fifty-six hours after the operation. The pylorus and the upper part of the *duodenum were squinty*, the small intestine was indurated. (*Medico. Chirurg, Transact.,* t. X, 1819. – *Archives de Médec.,* 1852, p. 335)

The Blundell observation is the only one in which transfusion was used to fight cancer. The result of the operation will not be surprising; if it was permissible to believe that this means could have advantageously altered the state of a patient suffering with a similar condition, it could not have been when life was about to die out as a result of the development of cancer. Would it have been the same if the transfusion had been performed as soon as the first symptoms of cancer appeared?

SIXTH GROUP
Blood transfusion performed in cases of diarrhoea, vomiting, severe dysentery

Bilious diarrhoea; transfusion; death, by Denys

A patient, who had been suffering from vomiting and hepatic flow for three weeks, had been purged in vain, bled and treated with various remedies. His condition seemed hopeless when he was determined, as an extreme attempt, to perform the transfusion. Denys did this while the patient being in lethargy had convulsions. After the first injection of 8 ounces, the convulsions stopped, the pulse rose, awareness returned, the patient was able to recognize the assistants and talk to them. He took broth without vomiting, and held on for twenty-four hours. There was a relapse for which a new transfusion was performed which led to a momentary return of strength; but the diarrhoea did not disappear, the patient succumbed to exhaustion fifteen hours after the last transfusion. At the autopsy, a very extensive volvulus was found and the livid intestines were ulcerated. (*Archives de Médec.,* 1852, p. 335)

The lesions observed at autopsy provide sufficient motivation for the termination of the disease and the failure of the transfusion. But from this observation, like all those

I have just reported, follow a very important fact: *It is the absolute harmlessness of transfusion in all circumstances where it was insufficient to save the patients*.

2nd OBSERVATION
Dysentery; intestinal haemorrhage; transfusion; died twenty hours later, by Dr. Thouvenet. (*Gaz. des Hôpitaux*, 1853, p. 236)

SEVENTH GROUP
Blood transfusion performed in cases of pulmonary phthisis

Blood transfusion in a case of pulmonary phthisis; improvement, by Dr. Blieding of Kischbarkan. (Gazette des Hôpitaux, 1842, p. 366*)*

This observation does not offer much interest. This is a young man to whom goat blood was transfused, and whose condition appeared to improve under the influence of this operation. The details are too incomplete for it to be necessary to make a more detailed mention of this fact.

In the eighth and final group are cases of transfusions performed for *ill-defined* conditions. These are the facts reported in the first part of this Memoir, and published by Denys, Richard Lower, Ed. King, Manfred of Lucca. From all these observations, in which the transfusion does not appear sufficiently motivated, stems this important fact: *The harmlessness of blood transfusion*.

'TABLE SUMMARISING ALL THE CASES OF TRANSFUSION REPORTED IN THIS MEMOIR'
This summary table, included in the original book (page 111) has not been reproduced in this translation - PL

The previous table contains all the cases of transfusion that my research has allowed me to collect. Out of 79 cases, blood transfusion was crowned 55 times with complete success. Of the 25 failures, 13 are legitimately explained by the conditions under which the operation was performed and by the lesions revealed by the autopsy. 12 times it failed. It follows that the number of successes is, in proportion to the number of setbacks, 5/6 to 1/6. *These figures speak loud enough and clearly prove that the unfavourable judgement against blood transfusion is not based on a careful and reasoned examination of the known facts.* They demonstrate, on the contrary, *that this method is a powerful weapon, as I have already said, in the hands of the surgeon who will be able to discern the cases where the application must be made and that its place must be henceforth marked among the most useful regular operations in surgery*.

This conclusion sums up the purpose of this first Memoir, where I merely made the history of transfusion from the point of view of physiology and pathology, thus seeking to fill a gap that exists in all conventional surgical treatises. But, I do not hide from myself that many new questions arise, the solution of which is essential, so that transfusion can spread in practice and is definitively accepted by surgeons. These questions, relating to the temperature of the blood injected, its quantity, its coagulation, the need for defibrination of this liquid, or the futility of this manoeuvre,

have been the subject of a large number of experiments which have led me to curious results, and which will be mentioned in a second Memoir. It was also essential to free transfusion from one of the most serious objections that could be directed against it, I mean the entry of air into the veins. The answer to this objection can be found in Part Three of this first Memoir.

But that's not all. After setting the operating manual and fully specifying the conditions for success, the question of indications will have to arise. Transfusion, which has led to such good results in haemorrhages, will it not be able, when it is better known, better performed, and above all applied more appropriately, to allow the doctor to overcome all these sick states in which the blood shows more or less marked alterations; is it not perhaps, finally, the most effective way to combat diathetic diseases, such as phthisis, cancer, etc., etc.? These are, I know, difficult points to elucidate, on which doubt will reign for a long time to come, but which experimentation alone can shed light on.