DIE TRANSFUSION DES BLUTES

BY: Dr JOHANN FRIEDRICH DIEFFENBACH (1828)

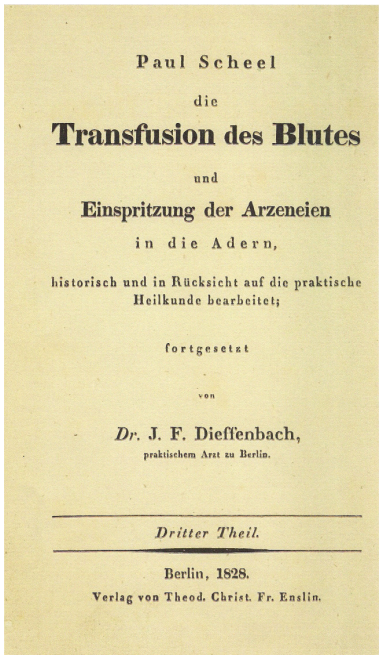
A TRANSLATION OF SELECTED SECTIONS OF THIS BOOK BY PHIL LEAROYD

The book 'Die Transfusion des Blutes', written by Johann Friedrich Dieffenbach, was published in 1828 in Berlin [by Verlag von Throd. Christ. Fr. Enslin] and can be viewed or downloaded at:

https://wellcomecollection.org/works/k2hqe2bf

https://books.google.co.uk/books/about/Die_Transfusion_des_Blutes_und_die_Infus.html?id=M_ZZAAAAcAAJ&redir_esc=y

The main title 'Die Transfusion des Blutes' is the same as the two volumes of Paul Scheel's book that were published in 1802 and 1803 respectively. Given this, and the fact that the main title page of this book also includes Paul Scheel's name, it is frequently credited as being his third volume. This is further confused by the fact that this book contains two title pages (see below), one containing Paul Scheel's name and the same title as his two earlier books, i.e. 'Die Transfusion des Blutes und Einsprützung der Arzeneyen in die Adern' [The transfusion of the blood and the injection of drugs into the veins] and another that does not include Scheel's name and has the slightly different title 'Die transfusion des blutes und die infusion der arzeneien in die Blutgefafse' [The transfusion of blood and the infusion of drugs into the blood vessels]. This 1828 book was in fact written by Dieffenbach and published seventeen years after Scheel's death (he died on the 17th June 1811) but, as explained in the preface, the author dedicates the work to Scheel.


Paul Scheel

die

Transfusion des Blutes

und

Einspritzung der Arzeneien

in die Adern,

historisch und in Rücksicht auf die praktische Heilkunde bearbeitet;

fortgesetzt

von

Dr. J. F. Dieffenbach,

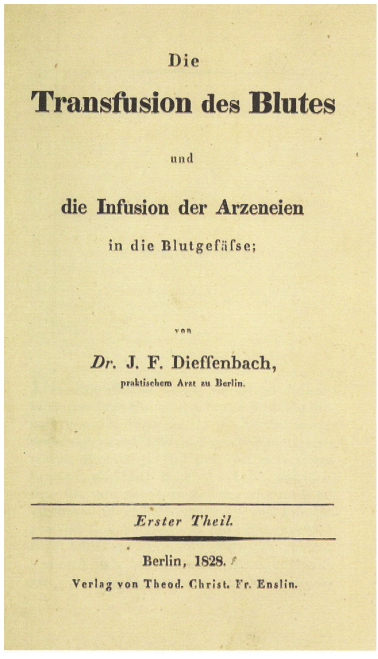
praktischem Arzt zu Berlin.

Dritter Theil.

Berlin, 1828.

Verlag von Theod. Christ. Fr. Enslin.

Title page #1: 'Die Transfusion des Blutes'
By J. F. Dieffenbach (1828)
(Image credit: Wellcome Collection)


Die

Transfusion des Blutes

und

die Infusion der Arzeneien

in die Blutgefäfse;

von

Dr. J. F. Dieffenbach,

praktischem Arzt zu Berlin.

Erster Theil.

Berlin, 1828.

Verlag von Theod. Christ. Fr. Enslin.

Title page #2: 'Die Transfusion des Blutes'
By J. F. Dieffenbach (1828)
(Image credit: Wellcome Collection)

As the ‘two titles’ identify, the content of this 234 page book includes information about both infusion and blood transfusion (the same as Scheel’s second book). It includes the work performed in different countries on these two topics for the time period from 1802 to 1827, but the overall content is very biased towards information regarding infusion experiments, which is due to the fact that, as identified in the introduction, little work was performed on blood transfusion during this period in Europe, except in England. As such, I have selected and translated only those sections of the book that include information about transfusion. Although the book does not include contents or index pages it is in fact separated into five sections that include information regarding the ‘History of Transfusion and Infusion from 1802 to 1827’ in Germany, (pages 4-92), France (pages 93-193), England (pages 194-224), Denmark (pages 225-227) and America (pages 228-234). The sections that I have translated are identified by section number, page number and title.

Therefore, although this book includes a short review of Tietzel’s work in Germany and a review of the work on transfusion by Magendle, Prevost and Dumas in France, the majority of the information on transfusion relates to the work performed by Blundell and colleagues in England. This includes an extensive resume of Blundell’s various individual experiments on dogs, as well as the subsequent human transfusions performed by Blundell, Doubleday, Waller and others in England. It is unfortunate however that Dieffenbach does not include the work performed in Italy during this same period by Michele Rosa (and others).

I have not amended the spelling of the names of any of the people identified in the book – they are the author’s own (e.g. ‘Blundel’, ‘Doubledy’, ‘Morecruft’, etc.). The original references relating to the text are printed at the bottom of individual pages within the book. I have sequentially re-numbered the ones included within the translated text and placed them as a list, as written, at the end of the translation.

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

The italics and ordinary brackets used within the translation are the author’s own. I have also maintained the same paragraph settings used by Dieffenbach, though I have included a small number of explanatory notes relating to certain words included in the original text, these are contained within square brackets.

JOHANN FRIEDRICH DIEFFENBACH (1794-1847)
– BIOGRAPHICAL INFORMATION

Johann Friedrich Dieffenbach was born in Konigsburg, Prussia, in 1794, where his father taught philosophy at the Gymnasium. When his father died when Johann was very young, the family moved to Rostock, his mother's family home. He originally studied philosophy and theology at the University there, but joined the Mecklenberg cavalry in 1813. After his discharge from the army in 1815 he returned home and studied medicine at the University of Konigsberg (1816-1820), after which he attended the University of Bonn to devote himself entirely to the study of surgery. Following visits to Paris and Montpellier he received his doctorate at the University of Wurzburg in 1822, after which he settled in Berlin, specialising in skin transplantation, plastic and reconstructive surgery. As well as his extensive work on reconstructive surgery of the face, he wrote on a variety of different topics, such as the treatment of urethral stricture (1826), better methods of bandaging (1829) and nursing (1832). It is during this period that he also researched infusion and blood transfusion, publishing *Die Transfusion des Blutes* in 1828. In 1832, he became an associate professor at the University of Berlin, and in 1840 became director of the Clinical Institute for Surgery at Charite Hospital where he focussed on reconstructive oral and maxillofacial surgery. He died in 1847 in Berlin, being now generally recognised as the founder of modern plastic surgery

Additional information:
https://journals.lww.com/plasreconsurg/Citation/1968/07000/Johann_Friedrich_Dieffenbach__1794_1847_.4.aspx

Johann Friedrich Dieffenbach (1794-1847)
(Image credit: en.wikipedia.org)

INTRODUCTION
(Pages 1-3)

Among the men of recognised repute with whom the history of the transfusion of blood and the injections of drugs into the veins ended in the last century, the immortal Bichat in France, Morecruft in England, Viborg in Denmark, but above all stands out the Italian Rosa, through a great number of ingenious experiments. Finally, Hufeland was a special promoter of this operation in Germany.

The study of physiology, which became more and more active in most European countries at the beginning of the nineteenth century, as well as the great advances in modern chemistry, which taught us a number of hitherto unknown substances that, hardly discovered, were immediately tested by experimenters to examine their effects on the animal organism; this led to a multitude of attempts at infusion into the vascular system, which, through solidity and thoroughness in observation, are very advantageous over most of the older attempts of this kind that in part still have the character of gimmicky or the most imperfect ideas of many forms of disease that were inherent in them.

It was the easy inventive spirit of the French, combined with their peculiar talent for the practical sciences that, especially in this period, gave us the most abundant yield for this subject, and the history of the past twenty-five years leads us past a number of men who, from a physiological or chemical point of view, made a number of most interesting experiments.

Infusion has found fewer workers in recent times among the English, partly because of a certain national aversion to all cruel physiological experiments on animals, partly because of the general inclination of English physicians for practical medicine and surgery; until finally, in the last few years, Blundel in London, the transfusion of blood, as a cure in the most desperate cases of bleeding, emerged again from the darkness of oblivion.

If one now goes through the whole range of all European nations with a quick overview, one sees that in the last twenty-five years the French have done most of the infusion of animals with regard to physiology, chemistry, and toxicology; the English most for transfusion, in view of practical medicine; the Germans, especially for the infusion of medicines, also as a curative purpose in various cases of illness, but the Danes did the same in relation to animal medicine.

Of all the other nations, from those of the north as well as from the Spanish, Portuguese and the like, we know nothing about these operations, and even the Italians seem to have contented themselves with what they learned about infusion and transfusion from German, English and French journals; at least none of them since Rosa has gone down this path with distinction.

Since, as already noted above, in the plan of this writing lies, to first compile all known facts, at least as far as I can find them in the more recent writings, and later to combine in this last volume all theoretical views and general conclusions from all infusion and transfusion experiments, and then to give an assessment of the extent to which a benefit for the medical sciences can be expected from these operations; I will go straight to the history of transfusion and infusion among the Germans without lingering any further in general reflections.

HISTORY OF TRANSFUSION AND INFUSION IN GERMANY: 1802 TO 1827
(Page 4)

The history of transfusion and infusion in Germany over the last 25 years only presents a series of incoherent experiments, and there is no unifying bond here, but these observations, both in physiological and therapeutic terms, are of the greatest

importance. During this period, individual physicians earned special merit for injecting drugs into the veins in desperate cases of acquired illness, but we see that the transfusion of the blood itself, as an experiment in animals, very neglected.

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§. 7.
E. Hufeland's recent transfusion effort.
(Pages 18-20)

Hufeland's recent inaugural treatise on the transfusion of blood and its applicability in asphyxia was the first publication to appear in Germany on this subject after a number of years. We last saw the same topic worked on by Haefner as an academic test script. (1) Scheel mentions it less of its instructive content than because of the rarity of seeing this subject dealt with as a dissertation in recent times.

The little treatise, only eighteen pages long, is divided into two chapters, the first of which is entitled *de sanguine ejasqiie praestantia in oeconomia animali*. The content, at least the largest part of this chapter, does not correspond to the heading, since the author enters into extensive physiological and natural-philosophical discussions. I am giving a sample here. "*Aquae circulatio calore interno e terra in superficiem efficitur, inde vapor ad aerern, undae ad rnare feruntur, in cujus motu aeterno vita ejus servatur. In aerem elevatur, ut summum gradum vitae fecunditatisque nanciscatur, per pluvias descendens, in lacubus fluviisque conveniat et terram nutriat, fertilernque reddat; denique omne animalium plantarumque nutrimenturn excretum, quod in hac via accepity secum provolvens, in mare fecunditatis receptaculurn recurrit. Eadem sanguinis circulatio: humores serosi et sanguis venosus, venis lymphaticis sanguiferisque in cor dextrum confluunt (mare) cujus motus sanguinem vivum conservat; deinde in pulmones surgit (aerem); ubi oxygenio caloreque maxime animatus, vitae elementum ac nutrimentum, vi cordis sinistri per arterias in corpus distribuitur, denique ad cor recurrit, postquam in via chylum in se receperit*."

In a similar spirit the author goes on for a while, describing with youthful imagination the life of the individual as part of the macrocosm and his relationship to it, but when reading these lines one always wonders what connection these theories have with the transfusion of blood in asphyxia.

Then he goes on to blood. Blood is the first and main element of the human body, the main principle of life; all manifestations of life are brought about by the blood; all altered states of the body can be explained by the blood. Blood diseases are based on 1) changes in the quantity or quality of blood, 2) on impaired vitality.

The second chapter contains the author's experiments; he chose sheep, which, because of their tolerance, seemed to him more suitable than dogs for transfusion. The apparatus was extremely simple and consisted first of a glass tube, later of two brass cannulas, one straight and one slightly curved, which fit into one another.

Transfusion into a sheep.
Two sheep were fastened next to each other on a perforated table, one after the wool had been sheared off the jugular vein, the other, through a deep incision on the inner side of the *sternocleidomastoideus*, the carotis, the straight tube in the jugular vein, the curved one fastened in the opened artery by means of a ligature, and then pushed into one another. In order to be able to calculate the amount of overflowing blood in a certain time, some blood was allowed to flow freely beforehand, which with every beat was ejected eight feet away by the force of the heart. As soon as a fair amount of blood had overflowed into the unconscious sheep, it immediately began to breathe deeply and forcefully, began to move, and began to give other signs of life.

Then it was brought back to the stable, where it seemed to be quite well, accepted feed, walked back and forth, and also did not get sick later.

Hufeland concluded from this experiment that transfusion, in the case of asphyxia through loss of blood, would be able to awaken life again,

Transfusion into a sheep.
A sheep was mechanically placed in a state of suffocation. It could not be brought back to life by air blown into the lungs, and the asphyctic condition was so perfect that there was absolutely no breathing. Some blood was now withdrawn from the animal, whereupon breathing and other signs of life gradually returned. It was then transfused with blood, whereupon there was a complete return of life.

It seems doubtful to Hufeland whether the bloodletting or the injected blood could have here brought about the preservation of life; most likely he assumes that the bloodletting preserved the life, but the transfusion brought about an earlier recovery, in which, in my opinion, he is absolutely right.

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§. 10.
Hoefft of the transfusion
(Pages 24-25)

This subject has gained little advantage through the editing by Hoefft; the dedications alone take up the first eight pages of his little dissertation, which appeared in Berlin two years after the previous one. In the preface he remarks that he did not consider the experiments he had made on animals suitable for communication.

This is followed by a short historical overview of the transfusion according to Scheel, and at the end a detailed description of the transfusion apparatus specified by Graefe. It consists of a wide glass cylinder, through the entire length of which runs a glass tube, at the ends of which curved metal cannulas, which are intended to be received in the vessels, are connected by screws. The cylinder has no other purpose than to be filled with lukewarm water in order to prevent the blood from cooling down as it passes through the bore. To complete this, and so that the right degree of warmth is always obtained, a small thermometer is inserted through the side opening of the cylinder.

The idea of this apparatus is certainly the most ingenious and perfect of all known. But it does not seem to me to be suitable for practical use, even for physiological experiments, because the blood has to travel too long a way through the tubes, and these are so narrow that coagula will immediately form in them.

The drawing of the entire transfusion apparatus, made by Linger, attached to the writing, is extremely clear. (2)

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§. 12.
Tietzel about transfusion.
(Pages 26-29)

We have recently found the most detailed treatment of transfusion in Germany by Tietzel in his academic test report. (3) The 73-page treatise is written with great diligence and a particular preference for this subject, but it is to be regretted that the author has not made any further experiments of his own.

The first attempt to transfer blood from one dog's jugular vein into that of another dog failed. It was not much better on a second attempt, where the blood from the carotid of one dog was to be transferred into the jugular vein of another, in that the

tube was very soon blocked by coagulum. The dog that had received the blood remained very lively. In a third attempt he let the blood flow into a calf's bladder by forcing it into the vessel by compressing the bladder. Here, too, the blood soon clotted, regardless of the fact that the bladder lying in the warm water.

Tired of experiments on smaller animals, he started the transfusion from one horse to the other. The apparatus consisted of a small tube made from the carotid of a horse, which was provided with quills on both sides. The horse that received the blood was 10 years old and suffered from silent madness, the horse that was supposed to give the blood was 6 years old and suffered from worms, from cutting the infra-orbital nerve, and very much attacked from great doses of narcotics. The first horse was given 10 pounds of blood drained from the jugular vein, whereupon there was weariness and trembling of the limbs. The pulse was 50 beats. While the blood was overflowing, the animals standing quietly next to one another, a distinct pulsation was heard in the tube. The blood was allowed to flow over for seven minutes, during which time the pulse was 75 beats, and the animal threw dung. Because it seemed to be in a bad state, 1 pound of blood was drained off again. Then it lay down with difficulty breathing. The heart beat weak and wavy. After half an hour a bloody mucus flowed from the nose, and the animal sweated profusely. This state lasted three hours, then there was a general cold, combined with convulsions, and death seemed near. After half an hour the animal was found floating in blood, since the ligature had come open again. The pulse was small, the respiration anxious, the skin cold, and the hind extremities stiff and paralyzed. The next day it could stand again, took food and water, the pulse was small and fast, the breathing was anxious, soon it sank again, got convulsions, and died the second night.

At the section, which was made the following day, the lungs were found to be very pale, and in the pericardium a little bloody water; the cavities of the heart contained liquid blood at a temperature of 25°; the substance of the heart was pale and brittle, the brain bloodless.

Tietzel concludes from this experiment that death is here not brought about by the foreign blood, but by bleeding to death. According to a fairly precise calculation, the animal received 12 to 14 pounds of blood, but when it was opened, a great void of blood was found. He considers the symptoms of the disease to be the result of the blood flowing over too quickly, which causes the right ventricle to overcrowd too quickly, which of course must lead to disturbances in the circulatory system.

The II. Cap. is about the finest transfusion devices, to which Tietzel adds a new one. This is actually a modified Blundel syringe; he remedied the evil that the blood was not soon passed faster, now more slowly, by means of a device of his own.

In what follows we will talk about the phenomena that accompany Tietzel as well as the means of preventing its evil consequences; dogs are said to die most easily from the blood of strange animals. Dog blood is not as suitable for testing as lamb's blood or calf's blood because it coagulates particularly quickly. As a precautionary measure in the operation he recommends:

1) that the blood should not be transferred too quickly;
2) that no air is allowed to enter;
3) that the amount of blood carried over is not too great;
4) that the tube should be carefully placed in the vessel so that the vein may not be inflamed; but especially he warns against leaving the tubule in place.

He does not dare to decide whether animal blood should be injected into humans. The frequent repetition of the operation is less dangerous than the single transfer of a large amount of blood. An asphyxial or anaemic must be given more blood than an apoplectic. He considers venous blood to be the most beneficial.

The IV. Cap. deals with the therapeutic value of transfusion; the opinions of the older experimenters are given, and the operation is recommended for low blood preparation, high blood consumption, asphyxia and blood flows.

Even if our experiences are not enriched much by this writing, one does not fail to recognize the author's striving for thoroughness, but in particular a certain preference for the subject is unmistakable.

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§. 17.
Schneider's views of transfusion.
(Pages 35-36)

Schneider expresses himself favourably in his psychiatry about transfusion, as a means that one must at least try in incurable cases of mental disorder; he is referring here to Hoffbauer, and believes that the transfer of blood can preferably be done where the patient's life force, as it were, has died, but where one should not fear its increase either. In this attempt the doctor is beyond all responsibility. He then cites the healing of the stupid by Denys in Paris, and King's and Lower's transfusions of madmen, according to Scheel, and closes this subject with the words: "It is surprising that this, albeit heroic, remedy has been completely forgotten in recent times and has fallen into oblivion, since in some cases, where all means leave us, and we are convinced that we declare the sick to be incurable, it could still render real service." (4)

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HISTORY OF TRANSFUSION AND INFUSION AMONG THE FRENCH: 1802 TO 1827.

§. 20.
Magendle's transfusion and infusion trials.
(Pages 123-124)

The experiments of this ingenious French physiologist occupy an important place in the history of this operation. In his *Précis élémentaire* he deals with this subject in greater detail than is the case in modern physiologies. As far as I am aware, I have compiled his experiments, which are scattered in other writings, as I have become aware of them.

What he says about the history of transfusion among his compatriots, however, contains obvious inaccuracies. Denys, the first to transfuse humans, is said to have turned a fool into a maniac; but Scheel has proved with the greatest thoroughness from the sources, that this man's wife, won by Denys' enemies, brought a false charge against him, as it turned out on closer examination.

Just as incorrect is the accusation that a prince of royal blood was a victim of this operation. The fact is that Denys transfused blood to the son of a Swedish minister, who was suffering from extreme emaciation as a result of an organic abdominal disease, almost dying, at the repeated request of the patient's relatives and doctors, and, as from the extensive, precise narrative rather prolonged his life by a few moments than shortened it. (5)

This refutation of the Magendle's statement seemed necessary here, since it has sometimes been regarded as a valid authority.

Magendie considers transfusion in humans to be a very daring means, but he urgently encourages experiments on animals.

In his own experiments he noticed that the transfer of blood from one animal to another of the same species did not cause any significant accidents, even if the amount of the foreign blood was very significant. But he considers that the main thing for the success of the experiment is that the blood should be passed directly from the artery of one into that of the other. But if the blood is first placed in a vessel and then introduced with a syringe, a small coagulum injected with it can easily cause death.

The same thing then occurs through blockage of the pulmonary vessels. All experiments in which one does not take this circumstance into account with scrupulous precision can be of no value. He often saw death ensuing, because the blood, which had to pass through a tube only two inches long, got partly congealed into the veins.

Magendie, on the other hand, regards infusion as an excellent means of quickly testing the specific effect of a medicament or poison on the body; it can also be regarded as the only and true remedy in cases of illness where ordinary medical treatment is inadequate.

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§. 26.
Dumas and Prevost's transfusion attempts.
(Pages 186-188)

It cannot be denied that, among all modern physiologists, Dumas and Prevost have shed the greatest light on the transfusion of blood, by a great number of the most ingenious experiments. Unfortunately, these experiments were of only incidental and subordinate interest for them, in their main investigations into the blood itself, which is why the relationship between transfusion attempts they have made is general and summarising. (6)

If they bleed an animal until it sank deeply into a deep faint, all muscular movement, breathing, and circulation ceasing, whereupon death tends to occur very quickly, and then injected water or serum again at 30°, life did not return. If, on the other hand, blood was transfused from another animal of the same species, life gradually awakened again during the transfer, and perfect production took place immediately.

If blood was transfused from a strange animal, whose globules were of the same shape, but either larger or smaller, the restoration was imperfect, and death occurred before the 6th day; the pulse was always accelerated, but breathing was normal, the temperature of the body decreased more and more if it was not artificially maintained.

Incidentally, they found it completely indifferent whether fresh blood or blood that had stood in a vessel for 24 hours was injected, and it made no difference whether the fibrous material was kept liquid by previously shaking the blood, or removed, or finally, obtained with caustic soda in the dissolved state.

In many experiments in which cattle and sheep blood was injected into cats and rabbits, resuscitation took place, the blood might have been left alone or had stood for 24 hours, but the animals died soon afterwards.

Injections of blood with circular spheres into the vessels of a bird caused violent nervous accidents similar to the most severe poisoning; death was always sudden, even when a very small amount of blood had been injected. But it happened less quickly if the animal had previously been rendered weak by draining part of its blood. These experiments were made on ducks with sheep's blood.

Taken together from all their experiments, Dumas and Prevost conclude that transfusion in man must be discarded until we know more precisely, in effect, the principle in the blood.

§. 28. [Note: This follows immediately after §. 26 – there is no §. 27.]
Patissier on transfusion as a remedy in diseases.

The well-known Patissier, who edited the article *Transfusion* in the *Dictionnaire des sciences medicales*, which is highly incomplete and even contains some inaccuracies, has a very harsh judgment of this operation: *nous ne chercherons pas ä prouver combien était ridicule cette opération que l'on a regardée cornme devant conduire à l'immortalité: le lecteur doit être assez pénétré des principes de l'économie animale, pour que nous n'ayons pas besoin de lui inspirer de l'éloignement pour ce moyen dont nous n'avons fait mention ici que pour l'histoire de l'art*.

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HISTORY OF TRANSFUSION AND INFUSION AMONG THE ENGLISH: 1802 TO 1827.
(Pages 194-224)

The history of transfusion and infusion throughout the previous century is dealt with by Scheel in the last period of his work. Apart from a few insignificant attempts at infusion in animals in support of this or that physiological view, nothing is found in this long period of time that deserves closer consideration. Only the last of these experimenters, the famous veterinarian Morecruft in London, made numerous experiments on infusions with animals, especially with *Veratrum album*. But from more recent times, from the beginning of this century to a few years ago, when Blundel and his students began to practice transfusion again in people in desperate cases of bleeding, I have known absolutely no attempts made in England on our subject, least of all on infusion.

We therefore move on to Blundel, omitting a period of about 16 years.

§. 32.
Blundel's transfusion attempts.

Blundel, professor of physiology and obstetrician at Guys Hospital in London, has long nurtured the idea of reviving the wrongly forgotten transfusion as a cure for some hopeless diseases. This wish came to life when he saw a woman who had recently given birth, a young, incidentally healthy person, dying of a uterine blood flow that could not be stopped. He thought it probable that the blood of another person, injected into the veins of those dying of inanition, might be able to preserve life and bring about restoration. Experiments on animals, however, should first instruct him practically on this subject, and at the same time make him more familiar with the whole procedure of the operation. It seemed to him that trying himself was the best way to go, which is why he did not do much research about what others had done before him.

He must, as is to be suspected, have expressed his views on the transfusion, and the lively wish to see it applied in the most dangerous cases of bleeding, more often in his physiological or obstetrical lectures, for London seemed in a way prepared for this operation, and although the contradiction he found was lively, it was not attacked in the way one might have expected. Blundel dedicated his own pamphlet to this subject (7) after he had previously brought his experiences to the public knowledge through journals. We come first to the experiments made by Blundel on animals, which I will take in turn.

1. Injecting of arterial blood from one dog into the veins of another.

So much blood was drained from the open carotid of a dog that the animal appeared to be completely dead. This blood, collected and kept liquid, was re-injected by Blundel into the opened jugular vein. As the blood overflowed, the signs of life gradually returned, and a few moments later the dog was completely restored. (8)

This is how this experiment is related in the Lancet, but one of the following numbers of this journal shows that the experiment must have been misreported; for another letter, which the Lancet also reports, reads as follows:

"Sir, I hereby take the permission to correct Mr. Blundel's attempt at transfusion, which you have communicated, to the effect that 1) the dog, which was almost bleed to death, is not revived by its own blood, but by that from the carotid of another; 2) that Mr. Blundel advises transfusion in women not into the jugular vein but into a vessel distant from the heart; 3) that he does not take animal blood for this operation, but that of another person; 4) that Mr. Blundel considers the success of the operation to be particularly dependent on the speed with which the blood is transferred without lingering a long time in the instrument. The dog is still perfectly fine 14 days after the operation."

Linton, Guys-Hospital.

2. Transfusion of blood from the femoral artery of one dog into the veins of another.

The femoral artery of a dog was exposed, and a cannula was inserted into the opened vessel, through which eight ounces of blood had to flow out. Immediately fear, screams of pain, convulsions and fainting occurred. The abdominal muscles were slack and the blood seemed to have stopped circulating. A few seconds later Blundel injected six ounces of blood from the *arteria cruralis* into the femoral vein of the bleeding dog, whereupon the return of life was brought about by tension of the abdominal muscles and the greatly renewed circulation of the blood, whereby even the *thrombus*, which had formed in the femoral artery, was pushed away, to recognize again.

3. Continued injection of blood into a dog.

Blundel brought one tube into the thigh artery of a dog and another into the vein of the same limb. The blood that flowed out of the first vessel was again injected into the other, and this was repeated for twenty-four minutes, without the animal appearing to particularly suffer. Since, according to a fairly accurate calculation, 12 nosels [sic] of blood must have flowed out and injected again in 24 minutes, the whole blood mass of the dog had passed through the syringe more than once; as was further confirmed by the high degree of arteriosity of the blood at the end of the experiment.

4. Injection of human blood into a dog.

A dog was made to bleed from the femoral artery until it appeared to be dead; Blundel then injected him with human blood drawn from the vein, which had been exposed to the outside air for one minute. The dog was resuscitated, but death occurred after a few minutes.

5. Injection of human blood into a dog.

Six ounces of blood were drained from the carotid of a dog, whereupon the animal apparently fell dead. Immediately after this had happened, Blundel injected 10 ounces of human blood into the veins of this dog, which had stood in a vessel for only half a minute, whereupon the animal came to again. The pulse was 120 beats and was not intermittent. In spite of the fact that it was in perfect health, which was revealed by its cheerful demeanour and lust for pleasure, it appeared to have returned, but died 15 hours after the operation.

6. Repetition of the same experiment in four other dogs.

Three other dogs, which had been put into apparent death by blood loss, were brought back to life by freshly released human blood, but all died. The first died after a few minutes; in the second after a few hours; and finally in the third after two days, under the coincidences of pericardial dropsy.

A fourth strong dog, which had also received human blood instead of its own blood, remained alive.

7. Injection of dog blood into another dog.

Ten ounces of blood was drained from a dog by means of a tube placed in the *arteria cruralis*, whereupon, after an apparent death of several seconds, two ounces of blood were injected again from the crural artery of another dog. Before the death-like impotence occurred, there was fear at first, then reluctance and difficulty breathing, then gasping for air, and finally the abdominal muscles collapsing. The animal's feeling of fear was expressed by a peculiar cry of lament. A few seconds after the injection of the two ounces of blood was done, the dog revived; the abdominal muscles tensed, breathing became regular, and the circulation was renewed so vigorously that the clot of blood which had clogged the femoral artery was expelled.

8. Repetition of this experiment.

Blundel drained 5 ounces of blood from the carotid of a small dog. The apparent death that then occurred hardly lasted a few seconds, since the injected blood of another dog immediately called it back to life. In a few moments the dog was made to jump from the table.

9. Injection of a dog's own arterial blood into its veins.

Cannulas were attached to the carotid and the jugular vein of a dog, the draining arterial blood was collected in a cup and injected into the vein. After six ounces were transferred in this way, a short break was taken. After a few minutes a new injection of six ounces occurred, and soon another injection of four ounces. At first the pulse stopped, then it became regular again. The animal's apparently great languor soon subsided.

The irregular heartbeat, Blundel believes, is due to the fact that the injection was too rapid, since of course the strong pressure on the plunger of the syringe had forced the blood too forcefully into the right cavities of the heart. Also 3-4 drachmas, which were injected at one time, were certainly too great a mass of blood, which

must arouse accidents, which also did not occur when smaller quantities were injected.

10. Repetition of this experiment.

The same experiment was repeated in another dog, and the arterial blood was re-injected into the veins in four batches, with long intervals, with about 1 drachm of air entering with it by chance. At first the pulse intermittent, but later it showed no further irregularities. The air ingress did not arouse any coincidences.

11. Injection of human blood into a dog.

A little over seven ounces of blood was drawn from a large, strong dog, and six ounces of human blood was injected again. The animal was indeed awakened from its death-like condition, but it died after a few seconds. An equal amount of dog blood would, in Blundel's opinion, have certainly preserved life.

Another dog was injected with six ounces of human blood instead of eight ounces of its own drained blood. Some air accidentally got into the veins. Soon after the injection, the apparent death ceased, but after a few minutes of gasping for air, cramping, yawning, vomiting, and then death, which was preceded by an hour-long fainting. The air entry was not to blame.

12. Repetition of these attempts.

Four ounces of blood were drained from a dog, and for this purpose ½ ounce of human blood was injected into it in six steps. The apparent death was not complete. After two minutes there was thirst, lassitude, and weakness; the pulse could hardly be felt. Coincidences soon followed suit, and on the third day there was an apparent recovery; but two days later the strength sank again, and on the 6th death followed. At the autopsy the pericardium was found filled with water, but no trace of inflammation or accumulation of water in other cavities.

13. Injection of human blood into a dog.

Another dog of delicate build was injected with five drachms of human blood in five batches. Each pause lasted only 30-40 seconds. Slight breathing difficulties, deep sighs, irregular pulse, and tremors in all limbs were the symptoms that occurred after the operation. After the dog was untied, it seemed to be quite cheerful. On the following day, however, it became weak and sad, vomiting and intermittent pulse occurred. On the 3rd day, however, there was complete recovery.

Blundel attributes these coincidences solely to the great fearfulness of the dog, which, especially in fearful animals, leaves long lasting impressions.

14. Blowing air into the same dog.

For the dog just thought of, after a while, Blundel had three drachmas of air into the crural artery. As the animal was less anxious this time, no further coincidences occurred.

From this experiment, Blundel concludes that even the air, blown into the blood-vessel system, does not produce any harmful effects.

After injections of cold water or weak wine, dangerous accidents never occurred.

Blundel's conclusions from transfusion experiments in animals.

The death-like state into which an animal is put, by a great loss of blood, lasts for a long time and a shorter time. With dogs it lasts 2, 4, even up to 20 minutes. An animal cannot be called back to life by transferred blood if, after having stopped breathing and the abdominal muscles sinking in and slackening, it is left in this state for 10 to 64 seconds, even if at the same time, one applies lukewarm baths and blows in air.

The extremely rapid coagulability of dog's blood sometimes leads to death even after it has been transferred over. In one case, a dog's autopsy showed a blood clot in the heart. The following experiment shows that life can only be preserved by injecting blood into the veins. Blundel injected fresh blood into the veins of a dog, which incidentally received absolutely no food. In this way, within three weeks, the dog received 83 ounces of arterial blood, partly by syringe, partly by direct transfusion into the jugular vein.

The following are the results that Blundel received from his transfusion attempts, which he used to answer the question of whether arterial or venous blood was better suited for transfusion.

On the whole, says Blundel, arterial blood seems to be more suitable to lead than venous blood. A much smaller amount of blood than the loss is sufficient in animals to prevent death, but one cannot replace a great loss of blood with the blood of another animal without danger. Incidentally, the blood can be safely stored in a vessel that is protected from the air and, which can be prevented from cooling down by placing it in a dish of 96^{o} Fahrenheit.

The following experiment proves this.

Transfusion of dog blood into a dog.

A dog weighing 15 pounds, 2 ounces, let the blood flow out of the carotid and, by means of its apparatus, squirted other blood into the jugular vein. Small clots formed in the cannula of the instrument, but the passage was not obstructed, and an air bubble passed over with it. The animal did not seem to have been particularly affected by the operation, which had lasted 65 minutes, for before it the pulse had 174 beats per minute, after which it rose to 160 without stopping. The breaths were counted, 26 in the same time. After 3 hours the number of pulse beats was still the same as that of breaths 30. The animal appeared to be weary and had stretched out; if you drove it on, it could go. On the following day it still seemed to suffer; on the 3rd day it was already very abundant, but on the 4th it seemed to have been completely restored.

Blundel calculated that the syringe he was using would take half a pint, or eight ounces, in a minute. Blood, that is, at least 12½ pounds of blood in 25 minutes, expelled almost the whole of the dog's entire weight.

The length of the tubes and surfaces through which the blood had to flow from the artery of one dog into the vein of the other was at least one and a half feet.

Description of Blundel's transfusion apparatus.

Before I turn to Blundel's experiences with transfusions in humans, I will here describe the apparatus, which he mostly used for the transfer of blood in animals.

This apparatus consists of a stationary syringe, a funnel for taking up the blood, tubes, and finally a frame. The tubes, which are located on the instrument, are provided with a tap, which can be turned in two different directions. Through the first of these tubes, which is elastic and at one end is connected to the syringe, its contents are emptied through the cannula, which has been introduced into the vein of the animal.

The second, non-elastic, tube leads the blood from the funnel into the syringe; it is connected to the funnel on one side and the socket on the other, and is curved at right angles at both ends. The tap forms part of the socket, and when it is turned a quarter turn the evacuation tube is opened and the inlet tube closed, or vice versa. The syringe, as the centre of the whole apparatus, rests in an upright position on a straight post, the bottom of which is weighted with lead to prevent the instrument from swaying.

All the pieces are made airtight. The syringe is made of brass and holds 11 drachmas. The emptying tube must be made of flexible leather, the inlet tube of flexible metal, the former so that the attempt is not disturbed by the animal's movements, the latter to place the funnel. The pillar to which the syringe is attached must also rotate.

Valves could also be placed where the tubes communicate with the syringe to allow the blood to flow, but the device with a stopcock is always most convenient because it is not so easily clogged with blood clots, and can also be easily made airtight.

If this device is to be used on people, a vein is opened in the hand or arm, the blood of one of the bystanders is allowed to flow into the funnel, from which it is sucked up through the metal tube, and by means of the elastic tube is driven into the vein of the patient. The plunger of the syringe has to be pressed slowly with the right hand and the tap directed with the left. Before doing this, it is necessary to drive the air out of the apparatus by filling it with water. An assistant must see to it that the funnel is always filled with blood. Blundel thinks that if experiments have shown that human blood can be exposed to the air for a few seconds without danger, one can let ½ nosel [sic] step into the funnel at one time. He protested against the objection that phlebitis could easily be produced by inserting a metal cannula into the vein, by saying that since transfusion is only used in the most desperate cases, fear of these consequences should not deter the doctor from the operation.

For general use, however, Blundel prefers an ordinary syringe to this apparatus, if only because it is easy to transport, since in most cases it is particularly important to have the tool quickly at hand where the life of a person is threatened by bleeding to death. (9)

Blundel's transfusion in humans.

The numerous experiments on animals had made Blundel so familiar with his subject, and taught him all the advantages and dangers of this operation, that he was now resolved to also use the transfusion in the first suitable human case. As early as 1818 he had read an essay on transfusion to the Medical-Surgical Society in London, in which, on the basis of his happy experiments on animals, he urgently recommended this operation in people who are about to die of bleeding. The long-desired case was finally found.

Transfusion of human blood into an emaciated man. (10)

A man, in his mid-thirties, who suffered from *Scirrhus pylori*, was admitted to the Guys Hospital. He suffered particularly from frequent vomiting and constipation. On

external examination of the abdomen, in spite of the great thinness, no tumour was found. The whole figure of the patient betrayed inadequate nutrition and blood preparation. The appearance of this person was, in the strictest sense, that of a skeleton covered with a yellow skin, the limbs were dried out and could hardly be moved, the pulse very small and weak, the veins, as it were, dried out, and now and then small livid spots visible on the skin.

The hospital's assistant physician, Dr. Cholmely, urged Blundel to perform a transfusion on this person, and thereby to extend his life a little, if possible. At first Blundel refused, by this daring attempt, which was nevertheless unable to save the patient's life, to risk the reputation of a remedy that he expected later, generally accepted, should save the lives of many people. After seeing this patient, however, he could no longer resist the desire to lessen his suffering, all the more so since he had the hope of possibly keeping him alive. When the suggestion was made to the patient that he should try this remedy, he consented to it; the operation was immediately carried out. The *vena cephalica* was exposed an inch, the vessel opened with a lancet, and then 12-14 ounces of blood were injected ten repeated times over a period of 30-40 minutes. Those present at the operation gave the blood. After this there was no noticeable change in the patient, only the pulse beat a little fuller and 3 to 4 beats more per minute. Soon afterwards the livid patches of skin on the legs also turned, and the patient's speech became a little louder and more audible.

In order to prevent the vein from possibly disappearing during the operation, a tube had previously been inserted under it. The small cannula, which was then inserted into the venous opening, was held only with the fingers, and the air contained in it was expelled by filling it with water beforehand. It took barely two minutes for the blood to be drawn in and transferred into the arm. Incidentally, the whole apparatus had been carefully prepared, the syringe had been warmed up beforehand, and the forcing of air into the vessel had been carefully avoided. Cline had indicated this device.

It was in the afternoon when the operation was performed; nothing special happened until evening, then the body heat increased, the pulse had 88 beats of double strength, the tip of the nose and lips reddened, and the patient moved his limbs with the greatest ease, saying in a fairly strong voice, "I am much better, and I am less dull."

Towards evening, however, there was again greater weariness, and during the night his strength decreased so much that he was worse the next morning than he was before the operation. He had an involuntary bowel movement a few hours later, and vomiting soon after. At 9 o'clock in the evening the outer limbs became cold, mild delirium set in, and death occurred 56 hours after the operation.

Blundel considers death to be brought about only by inanition; it is striking to him that three days after the operation the same symptoms of blood emptiness, that had been there before, reappeared, to which a white rash on the face, which he considers to be saline in nature, was added.

At the section the pylorus and the upper part of the duodenum were found to be cirrus; both formed a hardened, which exerted pressure on the bile ducts. The intestinal canal was narrowed and its inner surface degenerated.

There was no further change in the veins, which were carefully examined, except that the inner skin near the wound was darkly coloured, so that it looked like the surface of a coagulum. This altered colouration extended ½ inch upward, downward 2 lines [sic] wide. All the other vessels were perfectly healthy.

From the extensive conclusions that Blundel draws from this case, I only highlight the main points here.

For the patient, he says, who apparently only died of inanition, the amount of blood injected was far too small, so that one should not be surprised if after 24 hours

he sank again into the greatest exhaustion from which he had been brought out by the transfusion.

The slight excitement that followed probably contributed somewhat to the earlier extinction of life. Injecting a large quantity of blood or repeating the operation was considered dangerous by Blundel, given the sinking of his whole life, but especially with the weakness of the heart and vessels, as well as their diminished capacity, as he knew from experiments on animals that transfusion usually results in death after a few days.

For the future applicability of the same, Blundel also concludes from this case:

1. That transfusion by means of a syringe, which was used here for the first time on man, is very easy to set up.
2. That no danger for the patient is brought about if the blood is exposed to the outside air for a short time and is transferred by means of an injection, it remains suitable for the fulfilment of vital purposes, since in this case all life phenomena are evidently increased. But this does not prove sufficiently whether blood, which only directly fills the vessels, is transferred with the syringe, is not changed in its mixture in such a way that there is no need for blood preparation in the body. Only experiments, the basis of solid physiology, could solve this problem.

Blundel then raises the question of whether some of the patients in hospitals might not be preserved by transfusion, and who would also like to have it done to, if only one tried to give a clear idea of the operation. “Is there, he says, in physiology, where nutrition is discussed, a proposition that would be as important as this one? Who knows the many diseases to which it might not be applicable? Half the trouble that Spallanzani put into a single treatise would probably suffice to substantiate this proposition, and I should add that, if a naturalist could succeed, by diligent experiments on animals and observations on man something for transfusion to do, he would find a successor, and the matter would soon be promoted so far that the human race would derive a great advantage from it. In this consideration there is a great challenge that will not fail to have an effect on a noble and truly benevolent mind.”

We now proceed to some other experiments made by Blundel and his pupils Doubledy and Uwins on women who have recently given birth and whose life is endangered by great loss of blood. At the same time it does not seem uninteresting to occasionally share what has been said and healed in medical society about the individual cases.

First case (11)

A middle-aged woman, after the birth of a healthy child, developed such a violent flow of blood that he could not be nursed in any way. Face and hands were ice cold, and all signs of imminent death came when Blundel decided to use a transfusion. The haemorrhage had stopped for six hours; all sorts of irritants had been tried in vain to revive the patient, ammonium, brandy, laudanum, and the like, plus strong meat broth, egg-yoke and gruel.

The patient initially resisted the operation Doubledy had first suggested to her, but she eventually gave in to Blundel’s ideas. So 14 ounces of blood, which several of those present gave, was injected into her within 10 minutes. Already after the first 2 ounces the appearance became livelier, after 4 ounces the pulse beat faster, the eye opened more and the view became clearer. After 6 ounces had been transferred, the patient said that she already felt as strong as a strong dog; then the remaining 10 ounces were injected in several steps. The woman is perfectly fine.

In a Medical Society held at the beginning of October 1825, the lecture given by Doubledy on this case gave the opportunity for various discussions among the doctors who were assembled, which were continued in the next meeting. The far larger number of the members decided that the life of the sick was not due to transfusion, and the reasons for this seemed very reasonable. If the bleeding had stopped for six hours, the loss of blood was partly made up for, since the patient had eaten plenty of nourishing food, and had also received 20 ounces of brandy, 160 drops of laudanum, and ammonium. Then it was said, and certainly rightly, if the person was still so strong-willed that she refused to have the operation performed on her, she would certainly have survived without it.

Doubledy and Blundel countered these doubts as follows:

a) That although the bleeding had stopped for six hours, death would probably have occurred. In another case the flow of blood had stopped for ten hours, and yet the patient died;

b) Just as little should one ascribe the preservation of life to the stimulants used, their effect was only temporary, and after every glass of brandy the pulse was raised a little, but immediately dropped again;

c) Real improvement only occurred after the first 6 ounces of blood had been injected;

d) The person's resistance to the transfusion proves nothing at all for the patient's vitality; Doubledy even cited a case in which a woman who had recently given birth had to be forcibly prevented from jumping out of bed after a severe haemorrhage, and who, in spite of this increase in strength, died soon afterwards.

To this, Mr. Lloyd replied that transfusion is a dangerous operation, in which one still has to fear the transmission of diseases. In England and France it was often used in early times, but it was abandoned again because of its great danger; in the latter country it is even forbidden by the government.

The friends of transfusion, on the other hand, remarked, and very correctly, that in these cases animal blood had been transfused into humans, but according to Blundel's instructions only human blood could be used, whereby the fear of transmitting a disease substance could not be compared with the danger of bleeding to death.

The debates continued in the following meeting. Dr. Uwins appeared as a speaker in favour of transfusion this time. He was vehemently contradicted; he particularly referred to the older happy transfusions in France. One of the people gathered wrote the favourable success of the operation on the woman who had recently given birth, almost exclusively on the 160 drops of laudanum she had received, another said that most of them would like to have broken out again most of the time. Yet another thought that the transfusion was detrimental to blood flow, because the vessels would then be empty, but the right heart would be very full of blood. The matter was explained to this doubter as follows: the blood does not stagnate here, as he thinks, in the right cavities of the heart, and if it did happen, the transfused blood would act as a foreign stimulus on the heart, and thereby the circulation again getting produced. Real obstructions would be lifted by a strong injection of blood.

The impartial reporter of these discussions concluded with the words: "*these arguments are certainly ill calculated to influence such a man as Dr. Blundel*."

In the following Medical Society held on 14th November 1825, Dr. Uwins presented the report of another happy case of transfusion (12).

Blundel's and Uwin's transfusion in a woman who has recently given birth.

A middle-aged woman was happily delivered of a healthy child. The afterbirth came off the following day, whereupon a very severe haemorrhage, which lasted 1½ hours, made the relatives very worried for the woman who had recently given birth. Half an hour later, Uwins, to whom they had immediately been sent, arrived. The pulse was 130 to 140 beats and was small and contracted, the face of the patient was pale, and everything expressed the danger of the condition. Uwins wished that Blundel would also be called, who came after two hours. The transfusion was supposed to be carried out immediately, but they waited a few more hours as the patient's condition seemed to be improving. But when the strength began to drop again, they proceeded to the operation.

First they injected 6 ounces of blood, which Mr. Wright gave into the woman's opened arm vein. The face immediately became coloured again, and the strength seemed to increase, but after two hours there was renewed exhaustion, so that Blundel was obliged to give another injection of six ounces of blood, which Uwin was drained off. The pulse then dropped from 140 to 110 beats. The woman then gradually recovered and was soon completely restored. An inflammation of the venous wound, which caused some discomfort, was remedied by the addition of some leeches.

Before the transfusion began, every possible means of invigorating the patient had been used in the English fashion. She had got brandy, bread, milk, opium and ammonium.

The reasoning on this case given by the Lancet deserves no mention.

§. 33.
Doubledy's transfusion in a woman who has recently given birth.

In the Lancet (13) there is a short note about another transfusion, employed by Doubledy alone, in a woman who has recently given birth who died of bleeding. The case ended unhappily, but not solely as a result of the operation. The most precious time had passed in an unforgivable way before Doubledy was called, and when he finally came the woman was cold and almost dead.

The editor of the Lancet has no hesitation in communicating this unsuccessful attempt at transfusion without worrying that this would damage the reputation of this operation. He thinks it is better to communicate all examples, both successful and unsuccessful, to the medical public so that the latter can follow the course of the examinations all the better. On the other hand, Blundel is of the opposite opinion, who then wanted to know something about the transfusion brought to the public, when it had shown itself to be successful in several cases.

§. 34.
Brigham's attempt to transfuse a woman who had recently given birth.

Brigham in Manchester (14) also undertook the transfusion of a forty-year-old woman who had been so exhausted from a uterine flow that one feared her death.

At first two ounces of blood were injected into the arm vein by means of an ordinary syringe, without any noticeable changes. After a few minutes, the blood transfer was repeated, whereupon the pulse rose and the face of the previously pale woman revived. The injection of blood was now continued at intervals of 10 to 10 minutes, so that a total of 10 to 12 ounces of blood was injected.

The effect of this operation on the patient was really astonishing; she began to speak again now, since she had not been able to utter a word for six hours. What

was also particularly striking here was that the pulse became weaker after each injection of blood, but then rose again after five to ten minutes, and beat much more strongly. A few hours after the operation the patient sank into a deep sleep lasting several hours; from the moment she awoke her condition improved more and more, and she was soon completely restored.

§. 35.
Waller's and Blundel's transfusion of a young woman who had recently given birth. (15)

Soon after Blundel had another opportunity to perform this operation on a twenty-five year old woman who was in great danger of death because of a strong flow of blood from the uterus. The woman had been delivered easily, but the uterus did not want to contract again after the placenta had passed away, whereupon very profuse bleeding occurred. The pulse was small and often impossible to feel, the face and lips were pale and cold like a corpse, and there was hardly any sign of life. At Blundel's advice, who was present, the operation was postponed for an hour so that it could be brought to the absolute limit. But when there was violent vomiting and great restlessness, the pulse became mouse-shaped, often discontinuous, and the face took on a Hippocratic appearance, it was decided to have a transfusion.

The *vena cephalica* of the patient's right arm was opened, and two ounces of blood, drained off the young, robust man of the woman, was collected in a glass vessel and slowly injected into the woman. After a few minutes another two ounces were transfused, followed by some restlessness, frequent interruptions of the pulse for several minutes, and a brief fainting.

From that moment on the woman recovered and was perfectly restored. Blundel concluded from this happy case that the blood of a healthy man could be injected without any danger to a weak woman who had recently given birth and was exhausted by blood loss. The fainting was probably not caused by the injected blood, and was of no consequence. It is easy to object here that four ounces of blood are too small a quantity to resuscitate someone who is close to death due to a great loss of blood; but he thinks it has been agreed that under such circumstances even a very small blood substitute would be able to save a human life.

§. 36.
Waller's transfusion in a woman who has recently given birth (16).

Another case of bleeding, which Waller found soon after, gave him and Blundel an opportunity to do a transfusion again.

The patient was thirty-two years old, of a weak nervous constitution, very thin, and so emaciated from being sick for three weeks, especially from persistent vomiting, that she could not turn over in bed alone.

When Waller was called, contractions had already set in, and the loss of blood had soon become so great that the blood flowed through the bed to the earth. The patient's condition was extremely sad, the pulse was so small that the individual beats could hardly be distinguished from one another, often exhausting for a long time, but about 140 beats per minute were counted. The face and extremities were ice cold and the whole appearance was like a corpse, in short the patient, who could hardly utter a sound, seemed to be as close to death as anyone can be without really being dead.

On examination, Waller found severe haemorrhage; the *promontory* of the heiligenbeins [holy leg] too far outstanding, and no childbirth in the small pelvis. When the whole hand was inserted into the vagina, he was convinced that there was

a shoulder. As the patient was constantly fainting, he feared that a sudden emptying of the uterus would result in instant death, but when he noticed that the stimulus of the hand awakened some activity in the uterus, he was moved to carry out an artificial delivery. Previously the patient received a few teaspoons full of brandy. It was not difficult to turn the child, but the *promontorium* offered some resistance to the passage of the head. The afterbirth followed immediately and the bleeding stopped.

The patient now received whipped egg-yoke with brandy for refreshment, but she did not recover. The respiration was deep, the pulse scarcely perceptible, the body's coldness even greater than before, and the greatest restlessness was present.

Since death seemed to be very near, Waller decided to carry out the transfusion with Doubledy's help. Yet another hour passed uselessly until someone was found who would give his blood for it, since the woman who had promised to do it, at the decisive moment, did not want to keep her promise. A vein was opened in the arm of the man, who gave his blood out of favour, and the blood was poured into a vessel. During this time the woman lay there like a dead person, gave not the slightest sign of life, and did not even twitch when the skin incision was made.

The first injection of thirteen drachmas brought about no change other than a slight increase in the regularity of the pulse, and the restlessness also diminished somewhat. After 5 minutes the second injection of 13 drachmas took place, after which the pulse beat a little stronger. After another five minutes, 1½ ounces were injected. The pulse grew stronger now, beating 124 times a minute; but the great restlessness, the deep respiration, and the coldness of the body continued. The lips began to redden. Five minutes later, fifteen drachmas were injected again. The pulse was now beating 140 times a minute, the respiration was still more difficult, but the patient was able to answer a few questions.

Since the blood was flowing too slowly from the man's vein, after half an hour Waller drained 15 drachmas from his nephew, a boy of fourteen, and injected them. The patient's condition immediately improved, the pulse, which beat 130 times, rose, the face took on colour, and the warmth of the body returned. Damage to the syringe forbade further transfusing, and with the amount of blood transferred, which amounted to 8½ ounces, there no longer seemed to be any concern about death from inanition.

Waller observes that the foreign blood has produced no harmful coincidences at all, and believes that this is particularly due to the slow injection; as an eye-witness he had observed in experiments on animals that a rapid passage of blood produced dangerous coincidences, indeed, in the case of great exhaustion, caused death by too rapid overcrowding of the right cavities of the heart. Incidentally, the fact that in the woman the analeptic remedies had not contributed much to the resuscitation is sufficiently refuted by the fact that she had broken them out again. Under such circumstances, Waller thinks, the stomach is never strong enough to assimilate food.

At 1 o'clock in the afternoon Waller left the patient quite well. At 8 o'clock in the evening he found a comfortable warmth on the whole surface of the body. The pulse beat 140 times a minute, small but regular. The features were lively, the tongue clean and moist, but the stomach retained nothing but a little effervescent powder. The vein wound hurt a little. At 10 o'clock in the evening the condition was still the same, but there was some pain in the uterus. During the first three days the pulse always varied between 130 and 140, but the patient's condition improved more and more from day to day, regardless of the unfavourable external surroundings, so that after a week she was able to sit upright in bed. After 12 days the pulse beat only 100 times, the digestive power had increased so much that she could already tolerate a good deal of food, but it seemed that a considerable time was required to completely restore the woman, since she had already extremely weak before she had given birth.

§. 37.
Jewel, transfusion for a woman who has recently given birth (17).

The last transfusion known to us from England is the one that Jewel performed on a woman who had recently given birth and who was also close to death by bleeding.

The woman was of short stature and had given birth to a dead child with great difficulty; the afterbirth was quickly removed because of the heavy bleeding. After half an hour, cold set in because the blood was still flowing. The pulse was fast and barely palpable, the extremities cold. The patient received 40 drops of laudanum and *spirit. ammon. Aromatic*. Soon afterwards the bleeding stopped and the body was wrapped. Immediately afterwards the condition worsened so much that one had to fear imminent death. Another 80 drops of laudanum with brandy and gruel were given, and a little laudanum every 5 to 10 minutes.

Upon examination through the vagina, Jewel found only insignificant coagula in the uterus, which he removed and tied the body even more tightly. The patient was now receiving carbonate of ammonium. But since the hands and feet remained cold and the sweat of death had already broken out, it was decided to try transfusion.

Since the patient's arm vein was too small for the thickness of the syringe cannula, Jewel opened the jugular vein. The blood that the person was to receive was drained from her husband and collected in a vessel that was placed in warm water. The syringe used for the operation was small and only held 3 drachmas. Sixteen syringes full of blood were injected within 20 minutes, but since some blood was always left in the instrument and other things flowed by [sic], the patient might have received only 4 ounces of blood in all.

During the operation the condition changed little, only now and then a little nausea occurred, and towards the end the cannula was somewhat disturbed by the patient's restless movements. All apparitions indicated an imminent death, which actually occurred after ¼ of an hour.

The section was only permitted after 3 days. Particular attention was paid to whether some air had not been driven into the vein through the syringe and thereby caused the rapid death of the patient. The *vena cava superior* and *inferior*, together with the pulmonary artery, was therefore tied off and taken out with the heart. All of this was placed in a vessel with water, and covered with an inverted cup filled with water, the heart punctured under water, and saw about a drachma of air rise in it. The heart cavities contained only a little coagulated blood. The uterus was empty. The Conjugata was three and a half inches; the other pelvic diameters were also very small. The Promontorium formed a sharp angular protrusion.

These are the experiments and experiences with transfusion in England. Blundel, who, as a witty and respected doctor and physiologist, reintroduced this daring method into practice with all possible calm and prudence, seems to have caught a certain blind predilection for it, and attached great importance towards the injection of blood when there is danger of bleeding. But this is even more the case with his pupils and assistants, who, in their unlimited belief in the positive resuscitation and healing power of transfusion, hardly want to allow the objection that the sick, in whom it had proved helpful, could still possibly have been saved by other modes of treatment. Compare with this his lectures, some of which were insignificant, in the London Medical Society, and the mostly weak reasons for defending the operation. A more detailed discussion of their views will be found in the second volume of this book.

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HISTORY OF TRANSFUSION AND INFUSION AMONG THE DANES: 1802 TO 1827.

(Page 225-226)

The two Callisen are the only Danish scholars of whom I can give a brief mention on this subject. In fact, we find the doctrine of transfusion and infusion more detailed than in any other surgical manual in the old Callisen's system of surgery, which his nephew accompanied with valuable notes (18).

§. 38.
The two Callisen about infusion and transfusion.
(Page 227)

About transfusion, Callisen provides the following verdict: "This healing method, which was previously in great esteem, was almost forgotten because stupidity, nonsense, delirium, melancholy, heated fever and even death followed it, but it has recently been employed with success, and continued attempts must determine whether it can be done with certainty." These harsh and really unfounded accusations are only rumours spread by the old enemies of transfusion, but by no means credible facts. In the latter, on the other hand, that only continued attempts can determine whether the transfusion may be undertaken, one must fully agree with Callisen.

Conveniently, the nephew speaks out more favourably about it than his uncle. In fatal haemorrhages, he considers the injections of foreign blood not only the most natural, but also the only effective remedy. But also with emaciation, stubborn leprosy exanthema, open cancers, hydrophobia, imbecility, epilepsy and other similar evils, in which drugs so often fail the doctor, as in the case of pseudo death, transfusion deserves to be tried.

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HISTORY OF TRANSFUSION AND INFUSION AMONG AMERICANS: 1802 TO 1827.

§. 39.
Leacock in Barbados - transfusion trials in dogs.
(Page 229)

I note here with regret that I can only give an imperfect note of Leacock's, doctor in Barbados, transfusion experiments made on animals.
[Note: This is the only comment on transfusion in this section of the book]

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