‘TRANSFUSION’
DIZIONARIO CLASSICO DI MEDICINA INTERNA ED ESTERNA
VOLUME 45

EDITED BY: GIUSEPPE ANTONELLI

A TRANSLATION BY PHIL LEAROYD

This volume (number 45) of the ‘Classic dictionary of Internal and External Medicine’ (a first Italian translation by M.J. Levi) consists of 455 pages and nine alphabetical sections - its last major entry is ‘Transfusion’. A copy of the book, published in 1839 in Venice and edited by Giuseppe Antonelli, can be viewed or downloaded from the following site:

https://books.google.co.uk/books?id=B8FQAAAAcAAJ&dq=Peghelio&source=gbs_navlinks_s

The ‘Transfusion’ entry within this dictionary is essentially divided into three sections that are written by different authors who are identified within the text as being Figlio Andral, Rochox and Giovanni Pozzi. The surnames ‘Andral’ and ‘Rochoux’ [*sic*] are included within the list of ‘composers’ identified at the beginning of this volume, but Giovanni Pozzi’s name is not listed. There is no further mention about Figlio Andral, but the name Rochoux is identified as being a ‘Dottore in Medicina’ and credited as being an author within the sections ‘Patologica Generale’ (i.e. General Pathology) and ‘Mali dei Paesi Caldi’ (i.e. Evils of the Hot Countries). This person therefore appears to be Jean-André Rochoux (1787–1852), who is credited with being the author of the first clinical and neuropathological description of cerebral hemorrhage and ischemia.

The first section written by Figlio Andral is a brief overview of the early blood transfusion events that occurred in France and England during the 1660’s, focusing principally on the work of Jean Denis in France as well as commenting on James Blundell’s work at the beginning of the 19th century in England. Interestingly, the author believes that the death of the demented Antoine Mauroy was caused the injection of air into his veins as a result of poor transfusion technique by Denis and Emmeretz and not as a result of poison given by the man’s wife, the ruling made by the court in Paris on the 17th April 1668 that also prohibited transfusion unless it had the approval of the Medical Faculty of Paris.

The second larger section by ‘Rochox’ titled ‘Of blood transfusion and the injection of remedies into the veins’, includes more historical details of the history of transfusion covering its ancient history and especially the work performed by Italian researchers (including claims for Italy of a number of discoveries which the world persists in attributing to workers of other nations) as well as that of people in other countries, especially France and England. As the title identifies, this section then goes on to include details of the research that involved the injection of various substances into animals performed in various European countries, some of which are described by the author as being based on ‘strange theories that insulted reason’. Note: This section includes some graphic details of the fate of what would now be considered the unacceptable treatment of various animals used in these experiments at that time.

The third part of the ‘transfusion section’ by Giovanni Pozzi is essentially written as a summary of the contents of three different publications about blood transfusion. The first summarizes and comments on the extensive contents of a paper that is identified as being ‘Ricerche fisiologiche sulla trasfusione del sangue’ [Physiological research on blood transfusion] by ‘G. F. Diefenbach’ [J.F. Dieffenbach], the reference for which is given in the text as being *Rust's, Magazin für die gesammte Heilkunde, XXX, Bd 1829*. The name, title

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and reference given for this paper are however all incorrect and the correct reference should be: Dieffenbach, J.F. (1830) Physiologische untersuchungen über die transfusion des blutes [Physiological studies on blood transfusion] *Magazin für die gesammte Heilkunde*, 30, 3-81. A copy of this paper can be viewed or downloaded from: https://books.google.be/books?id=dkhAAAAAcAAJ&printsec=frontcover&hl=nl&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

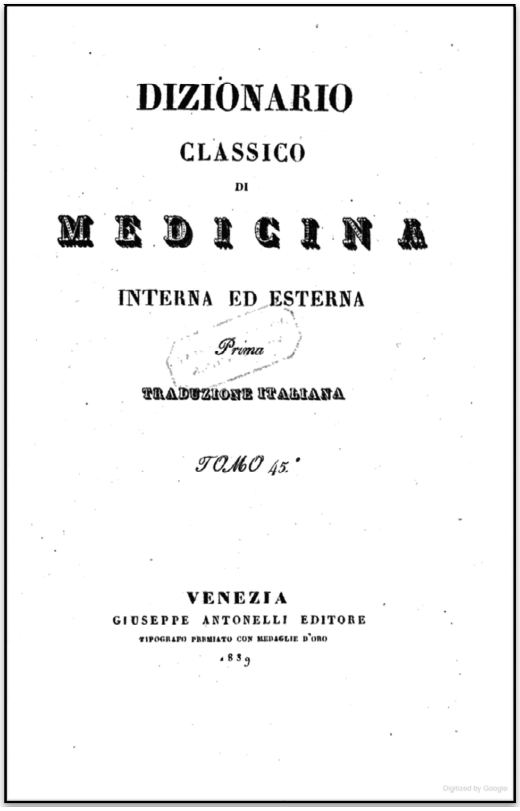
This section therefore summarizes the results of the numerous transfusion experiments that Dieffenbach performed between different animals (mammals, birds, fish, invertebrates, etc.) identified within this publication that were designed to essentially assess if blood transferred between different species is compatible and if the blood can be stored before it is used for transfusion.

This section then continues with a summary of a case study titled: Perdita di sangue uterina ribelle ad ogni sussidio guarita colla trasfusione [Uterine blood loss rebellious to any aid cured with transfusion] about a 28-year-old woman suffering from metrorrhagia that was treated with a blood transfusion performed by a 'Dr. Banner of Liverpool'. The section ends giving the reference *The London Medical and Surgical journal, junii 1833*. The reference to this paper can therefore be identified to be: Banner, J.M. (1833) Clinical Report – Transfusion. *London Medical and Surgical Journal*, 3, 588-591. A copy of this paper can be viewed or downloaded from: https://books.google.co.uk/books?id=dYVDaNiiYaQC&pg=PA493&source=gbs_selected_pages&cad=1#v=onepage&q&f=false

There then follows a short section titled: Caso di transfusione del sangue del dottor Berg [Dr. Berg's blood transfusion case] that describes the transfusion of a 39-year-old multiparous woman with metrorrhagia treated with a blood transfusion. The section ends with the reference: *Medizinisches correspondenz. blatt des Würtembergischen arztlichen Vercinis herausgegeb. von den D. D. Blum-Hardt. Duvernoy und Seeger 1838, Nr. 2* [Medical correspondence Journal of the Würtemberg Medical Vercinis, published by D. D. Blum-Hardt. Duvernoy and Seeger 1838, Nr. 2].

I have translated the 'Transfusion' section of this book from Italian 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 available, this process struggles with accurately reading the original text and specialist terminology as well as producing a 'colloquial style' not always representative of the original text. I have not therefore used this methodology and have taken great care in accurately identifying the original text and producing a representative translation. In addition, an 'automatic translation' may purposely or inadvertently alter the wording to 'make it read better' but in doing so there has to be an element of personal interpretation involving something on the lines of 'I believe that this is what the author is actually trying to say'. I wanted to avoid that as much as possible and try to present what the author actually wrote and as a result the reader may find that the English text does not 'flow' as well as it could.

Although I have taken great care not to misrepresent the author's original wording I cannot guarantee that this work does not contain 'translational errors' and the reader is recommended to check specific details against the original Italian text. I have reproduced the spelling of the names of people and places as they appear in the original text but where appropriate have added corrections/alternatives to these, placed within square brackets directly after. I have maintained the original paragraph settings and have reproduced the text that was originally printed in italics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CLASSIC DICTIONARY OF INTERNAL AND EXTERNAL MEDICINE
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'TRANSFUSION'

(ANDRAL figlio)
TRANSFUSION, n. f., *transfusio*, to be *transfunded*, decanted, poured from one vessel into another; operation by which foreign blood is introduced into the veins of a living animal. In other cases, to carry out the transfusion, the end of a tube was placed in the artery of a living animal, and its other end was then inserted into one of the veins of the person into whom the blood was to be transfused; once the tube was in place the operation was carried out by itself; nowadays you take the blood with a squirt, and inject it into the vein like any other liquid.

If we are to believe lamartinere [La Martiniere], transfusion would have been known and practiced by the ancients; it is certain, however, that for moderns it only dates back to the middle of the seventeenth century. First attempted by Wren in England in 1664 on animals, praised by Major in Lamagua [La Magia], it was first practiced in France on man by Denis and Emmerets [Emmerez/Emmeretz] in 1666. The following year their example was followed by Lower and King, and in 1668, two Italian doctors, Riva and Manfredi, also performed transfusion experiments on humans. Public attention however turned, especially to the operations of Denis and Emmerets [Emmerez/Emmeretz], given the attacks carried out by Lamartiniere [La Martiniere] and Perault, and in particular given the sentence of the Castelletto court dated 17 April 1668, which prohibited transfusion until it has had the

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approval of the Medical Faculty of Paris which, as is known, never granted it. From that moment until our time, when it was attempted again, this operation was unanimously considered dangerous and completely abandoned.

The disapproval with which it has been subjected for such a long time will certainly seem reasonable, if we want to remember that among the numerous accidents which transfusion is accused of producing, as opposed to some dubious successes, the death of a madman for whom Denis and Emmerets [Emmerez/Emmeretz] had practiced it twice, hoping thus to cure him of his madness. At the third operation, the unfortunate patient shouted, as it began, *stop, I'm dying! I'm choking!*, and as a result he died shortly after, certainly due to the effect of the air that a bad operating process would have introduced into his veins.

This accident, moreover, is not the only one that must be feared from transfusion; it can adduce several others which had already been foreseen, and of which Prevost and Dumas showed the reality, making known the main causes (Bibliot. universale, t. XVII). From their experiences it appears that the introduction of blood in spherical globules (*see* BLOOD) into the veins of birds quickly causes death due to actual poisoning; but these ingenious experimenters succeeded in reviving in a truly surprising way some animals close to expiring due to excessive hemorrhages, by injecting blood taken from an animal of the same species into their veins. If, instead of this, they resorted to the blood of animals of a different species, although supplied with similar globules, the injection also produced prompt relief, but did not prevent the animal subjected to the experiment from dying within six or eight days.

For his part, Blondell [Blundell] managed to make many animals live for a long-time, without giving them any nourishment, only by injecting blood into their veins (Archiv. general. di medicin. December 1825). To tell the truth, he was not so lucky in applying transfusion to a patient suffering from cirrhosis deep into the pylorus; because the alleviation produced by this operation was of little value, and the disease however quickly became fatal. Nor was there any better success in the hands of the same doctor, in an individual exhausted by stress and considerable hemorrhage.

Taking these different results into account, Waller and Doubleday were both induced to try transfusion (Archiv. di medicin. December 1825, and October 1826). Their experiments were carried out successively on three women who had fallen into frightening weakness due to very copious uterine hemorrhages. The injected blood was taken from the vein of a man, and the recovery of the sick was so rapid that it could reasonably be attributed in part to the good effects of the transfusion; it is therefore perhaps legitimate to admit that in similar cases this operation can be of some use.

As for the possibility of achieving with its means the conquest of all diseases, and even of prolonging life indefinitely, as some doctors hoped, the reader should not expect that I will seriously combat this chimera; assignment, moreover, which was perfectly fulfilled in the Encyclopedia, article *transfusion* and in Planque's dictionary volume X; I will therefore limit myself to suggesting reading to those who desire more historical information than those to which I have limited myself.

(ROCHOX)

Of blood transfusion and the injection of remedies into the veins

- The experiment on transfusion had the names *methaemochymia, trasplantatio medica nova, cura medeana*; and the one with the injection of the remedies into the veins had the names of *infusio or infusoria surgery, clysmatica nova*. These operations were, according to some writers, known to the Egyptians, and that Medea, the renowned sorceress of antiquity, learned the art of using them from the Egyptian priests. However, there is no mention in the histories of Herodotus, Polybius, Apollodorus, Pausanias, Hyginus and others, that the Greeks knew about blood transfusion and the injection of remedies into the veins; yet if such tests had been made by the Egyptians the Greeks would not have left them neglected. The Greek historians speak only of Medea's spells with herbs, baths and anointings, and that in

this way she rejuvenated the old; nor do they say at all that it introduced blood and remedies into the veins. It is a blind impulse of poetic enthusiasm that Ovid has in his Metamorphoses, which makes him say that Medea rejuvenated the white-haired Aeson, father of her husband Jason, taking away his old blood and replacing it with youthful blood.

The stories begin only in the fifteenth century of the common era, reporting that the Florentine Marsilio Ficino had discovered the way to perform blood transfusion, and they cite his work *De vita lunga et coelesti*. But there are many truths disfigured by magic words and enigmas, and even the clues to these trials are entangled in the veil of mystery and the chaos of superstition, which the expert investigator nevertheless manages to bring to light and at the same time tie together, whereby united by giving each other value, it is possible to establish that he knew of transfusion. Then Peghelio Magno [Magnus Pegelius], professor of mathematics in Rostock, made it known in his *Thesaurus rerum selectarum*, published in 1604, that he was aware of transfusion and injection. In fact, as he says *Ratio chirurgica insignis, et rara homini comunicans exterà quae ipsi bona et interna multa quae moxia avertens. Quae ratio alias varia agere, et alterare in homine possit*: words must not be understood *Ratio chirurgica insignis et rara homini comunicans extera quae ipsi bona*, that he used ordinary means, but rather a new and extraordinary method; and it certainly could only be that practiced by means of blood transfusion and the injection of remedies. Shortly after Andrea Libavio [Andreas Libavius] of Halle, i.e. in 1615, stated in his *Appendix necessaria, Syntagmatis arcanorum Horum* in a more decisive way than transfusion and injection, and called its inventor an empiricist, who, according to some writers, it was Peghelio [Pegelius] himself who was already doing various tests; nevertheless neither Libavio [Libavius] nor Giovanni Colla, [Giovanni Colle] professor in Padua, who also made mention of it, left any mention of the process that was held in these trials; and it was only a few years after the discovery of the circulation of the blood that there were extensive and regular descriptions of it. Discovery whose glory is entirely due to Andrea Cesalpino [Andreas Cesalpinus] of Arezzo, as is clear in the fifth book, chapter. 4. *Quaestionum perepateticarum*, and in the second book, chapter 17. *Quaestionum medicarum*. But the timid Italian discoverer did not take the necessary care to spread his discovery and did not take into account those means that give luster and fame even to the petty things of a clever author. The Englishman Gugliemo Arveo [William Harvey] profited from such neglect, and full of stolen glory, it quickly spread far and wide in 1619, what product of her sweat does the Italian strip; no wonder! there are many Italian virtues with which foreigners covered their nakedness and took the name of their own: and only fraudulent cunning places on the still damp papers of whose written robberies bitter and unjust sayings of those who had the right to genius were written: against the teacher, the learned and modest Italy, and the same happens with the great discovery of circulation. Cesalpino [Cesalpinus], after long turning pale with the anatomical scalpel on the living and the corpses, said: *sanguis fugit ad cor tamquam ad suum principium. Cor non solum arteriarum sed venarum est principium ... arteriarum ramusculos, qui cum venis committuntur. ... Sic non obscurus est hujusmodi motus in quacumque corporis parte, si vinculum ad hibeatur, aut altera ratione occludantur venae: cum enim tollitur permeatio intumuseunt rivuli qua parte fluere solent...* He knew the circulation of the blood well, and Arveo [Harvey], having left a few years of more propitious silence to pass, not in vain, placed himself ahead of him, called himself the author and received the acclaim. There were few who claimed responsibility for the discovery in Italy: their voice was weak, it was suffocated by the heavy crowd of partisan writers or blind followers: so that up to this day the opinion remained firm, that the blood circulation was the discovery of Arveo [Harvey]: and must Italy suffer that such damage is passed on to later posterity if a sacrilegious lie is committed by the immortal Allero and by the medical historian the illustrious Sprengel? Let the truth be snatched from the hand that suffocates it; let the name of those who possess the merit be engraved and spread everywhere with sensational notes.

The circulation of the blood was already known by some, and in 1642 a certain George of Wahrendorff began to inject wine and remedies into the veins of dogs using a straw, and then closed them. After Wahrendorff, i.e. in 1638, the Englishman Potter proposed transfusion to the Philosophical Society of London but had no followers. Wren of Oxford performed injections of remedies in dogs in 1656 and communicated his experiments to Robert Boyle, Wilk [Wilkins] and others, and to them he described the apparatus he used, which consisted of a syringe or a straw to which a bladder was tied. Among the various medicinal substances he used were the so-called diuretics, and he claims to have obtained excellent effects. He injected opium dissolved in warm Spanish wine into the veins of a dog who became staggering and so stupid that he thought he was lost: but not long after he fully recovered. Around this time, i.e. in 1652, Francesco Folli undertook blood transfusion, exactly as Paolo Sarpi reports in his « Stadera medica, nella quale oltre la medicina infusoria si bilancia la trasfusione del sangue già inventata da Francesco Folli. » [Medical steelyard, in which, in addition to infusoria medicine, blood transfusion already invented by Francesco Folli is balanced]. But this work was published only in 1680; and infusoria surgery was attempted not shortly after the transfusion, and Sarpi believed he could cure not only many diseases with transfusion, but he was so delirious that he claimed to rejuvenate and make men become giants.

The Englishmen Boyle, Klarke [Clarke] and Lower carried out experiments of transfusion and infusion, and in 1666 a Commission elected by the Philosophical Society of London, of which Lower and Bayle [Boyle] were members, attempted transfusion; but due to the imperfection of the instruments he was unable to carry it out. In the same year Lower described the method for performing transfusion easily and safely. Equivalent attempts were made with Lower's method which King corrected in 1667. Enthusiasm for transfusion was born, and in the same year the Frenchman Giovanni Denis [Jean-Baptiste Denis], bravely imagined carrying out such experiments on humans too. He made his plan known, and it was proposed to look for a criminal condemned to death, in order to carry out his work without regard and fear; and certainly a holy law would be that which condemned criminals in some cases to be exposed to medical experiments: Society, in exchange for having the sterile revenge of destroying a man who did them harm, could be richly compensated by the evildoer himself with the useful discoveries and the revelation of some medical truths that he could give her with his body put to experiment. But Denis, averse to languishing in the inconvenience of supplications, preferred to carry out his tests on a sleepy man who offered himself spontaneously. He took from this subject three ounces of blood which was black and very thick, and infused into his veins as much blood as he allowed to flow into them from the carotid artery of a lamb. He felt a great heat spread along his arm, causing the blood to flow and he said the pain that tormented him greatly after a fall had greatly diminished. Denis then had blood taken from him to examine it, and found it more fluid and redder. The patient, so the experimenter reports, was no longer drowsy and acquired clarity of mind.

Denis was encouraged by the happy outcome of this experiment, and with the help of money he had a 45 year old man expose himself to his trials. He drew ten ounces of blood from him, and compensated him with as much which he made flow through the veins from the crural artery of a lamb. During the experiment the subject was in good spirits, and said that he felt a grateful and extraordinary warmth that spread from his arm to his armpit as the blood penetrated there. After a sustained operation he found himself well and much stronger than usual.

These happy events gave rise to the most flattering hopes, and since Baron Bund [Bond] was close to death due to a hepatic and lienteric philụxus with bilious diarrhea (as the writer expresses it), Denis and Emmers [Emmerez/Emmeretz] forced themselves with prayers to try a transfusion. Having declared that there was nothing to hope for in such a case, since the patient was already lethargic, convulsive and with a tingling pulse, they set about the test and introduced three ounces of blood from a calf into his veins. Then his pulse rose, became stronger, and the convulsions ceased, and he, as if awakened from

lethargy, looked fixedly and full of amazement at the bystanders, his mind became serene, and they spoke in various languages; but this improvement did not last long and seemed to have happened by magic; 24 hours later the first deadly symptoms returned, the transfusion was repeated, but the beneficial effects were less, and the unfortunate man's calm was broken and he relapsed and died.

Denis reports the healing of a woman suffering from hemiplegia following a stroke, through the transfusion of twelve ounces of arterial blood from a lamb carried out several times.

Such facts intoxicated with strange hopes. The old ones were already happy to become dandy young men, the worn out ones to regain their health, muscles and strength; and everyone had already had the sweet dream of the immortality of life. But as usually happens with new discoveries that are welcomed with boundless enthusiasm, they multiplied blindly and the experiments were conducted not with the guidance of cold and scrupulous observation, but with a frenzied imagination intoxicated with miracles. The tests were therefore carried out carefree: they wanted to rejuvenate men and animals; but the unexpected and unfortunate effects that occurred degraded the insane audacity, and the death of the demented Mauroy which occurred, although recovered from his illness, two months after the experiments of Denis and Emmers, [Emmerez/Emmeretz] brought transfusion into disrepute, and with the same rapidity with which it was welcomed into France, it was also rejected there with horror; but as foolish as his fanatical elevation was, so was his abandonment. No consideration was given to whether the bad effects were necessary for the operation, or whether due to lack or error in carrying it out.

At the same time as the French, the Italians, the English, the Germans, the Dutch and the Danes made attempts. Fracassati, Malpighi, Mangetti, Cassini, Griffoni and Riva Piemontese distinguished themselves in 1667 and onwards by carrying out the transfusion of animal blood into men, and also obtaining good effects. Baglivio in 1685 injected half an ounce of spirit of vitriol (sulfuric acid) into the jugular vein of a large dog; immediately afterwards the animal began to shiver from the cold and stiffen, it vomited and spilled a lot of saliva, fell to the ground, panted and died shortly thereafter. When the corpse was opened, all the viscera were found black; the heart and lungs contained a lot of acrid and coagulated blood, the remaining parts were in a natural state.

Lanzoni tells us that he cured a dog suffering from terrible scabies by injecting an anti-scabies liquor into its veins. He injected an ounce of the best wine into the crural vein of a dog. Immediately afterwards the animal walked here and there without order and moved irregularly; and immediately afterwards he evacuated, sweated, threw himself on the ground, slept soundly for two days without eating or drinking, then he woke up, barked, ate, urinated and was fine. They are also named Pinelli, Pasta and Mazzoli, who successfully injected the spirit of deer antler into the veins of a 15 year old boy who had been bitten by a viper and was at the end of his life. The illustrious naturalist Fontana repeated the same experiment on calves and rabbits: but he did not obtain any good results. He injected the viper venom into rabbits' veins and they died in a very short time. Rosa infused a few pounds of blood from a calf into a heifer: the animal urinated twice after the operation and perspired heavily: nevertheless it turned out to weigh five pounds more, and from this plethora came neither inflammation nor extravasation. He transfused the arterial blood of a calf into the jugular of an almost fainted, dying lamb, and he recovered after having suffered some ailments, and became fatter than his companions. The immortal anatomist, the illustrious Scarpa, my teacher, also performed a transfusion in 1784 on a sheep which became livelier.

The English performed a transfusion in 1667, and used it on the insane, and according to King who was one of the experimenters, cures were achieved. The tests proposed by the Crown to find out whether one could live without food and air with blood transfusions repeated daily were ingenious, but the project was abandoned. Freind in 1705, Colbetch, Langrisch in 1704 and 1747, Harword in 1792, injected opium, mercurials, cinchona, sulfuric acid, lead acetate. A half ounce of spirit of ammonium salt introduced into the veins of a dog

produced death in a few minutes. With the section of the corpse it was found that the lungs were very red and almost inflamed, that the whole mass of the blood was very fluid, except the blood in the branch of the vena cava descending from the liver to the heart which was very thick and coagulated. In the ventricles of the heart there was a coagulated and almost pulpy mass. Seybert, introducing a small quantity of putrid and acrid matter, rotten matter, putrid blood into the veins, saw that death suddenly occurred, and with these facts he overthrew forever the theories of putrid diseases and circulating acrid, putrid humours. Strange theories that insulted reason.

Among the Germans was Major in 1664; then Elshotz who attempted the cure of ancient wounds by means of the injection of remedies, Garmann, Hotze and Fabrizio who infused remedies into the veins of some high-grade syphilitics and reported good results. Kaufmann, who says he healed a leper with the transfusion of blood from a lamb. The *courageous* Parmann dispelled an inveterate scabies in three days by having cochlearia water injected into his veins. Haller injected two drams of camphorated vinegar into the veins of a dog which immediately died, and found the blood coagulated and black; but not fibrously coagulated, as happens to be observed in other experiments carried out with wine spirit.

In 1701, Khon claimed to have cured a twenty-eight-year-old farmer who had been suffering for a very long time from a very pertinacious scabies which was not unlike southern leprosy by introducing essence of wood (*essentia lignorum*) with some smoke water into a branch of the crural vein. The author claims to have cured a grumpy arthritis with vehement pain, rebellious to every remedy, by injecting a mixture composed of half a dram of earthworm spirits, half a scruple of anodyne essence and two ounces of water.

Hemmann in 1778 introduced three ounces of a cinchona solution prepared in the following way into the median vein of a man suffering from lazaretto fever. He boiled a quarter of an ounce of cinchona in *a quarter* (*a quart*) of water; once the decoction had been filtered, he added two drams of volatile deer horn salt, and filtered three more times with waste paper. Due to his serious weakness, he did not risk drawing blood first, as is customary, according to some, in these operations, so as to leave, it is believed, room for the matter to be infused. After the operation the patient sweated and his pulse rose again. The sweat lasted all evening and the pulse was soft, but rather strong; after half a night the delirium began, the pulse dropped and the skin became dry again. The author repeated the injection at a dose of three ounces drawn before four ounces of blood, the pulse rose again and the strength increased; the following day there was a strong sweat and in the night a stinking diarrhea. He became the happiest patient, took a little biscuit with wine and soon recovered.

Siebold injected two drams of Tokay wine into the veins of a dog, and no harm came of it: he injected two drams of aqueous solution of opium in exchange and he died.

Mayer injected four grains of opium dissolved in four ounces of water into the veins of a dog; half an hour later the animal lay down and fell into a deep sleep from which it could not wake up. The author injected him with an ounce of vinegar, and an hour later he awoke and appeared sufficiently lively.

Military surgeon Black reports saving a soldier by infusing a solution of three grains of tartar emetic with warm water into the median. This subject could hardly breathe due to a large piece of meat stuck in his throat. The patient was in the most terrible situation; and having made all common attempts useless, death was certain. A quarter of an hour after the injection there was a strong urge to vomit; then a vehement vomiting occurred and the piece of meat ending in a thin long bone emerged and healing was established. The author recounts another similar case which ended happily with the same means.

The Dutch also undertook transfusion and injection experiments 1668; and Bils, Graaf, Heyde and Kerkring deserve mention.

Among the Danes, Bartolino and Borrichio gave proof of their knowledge in 1665: and the French had already resumed the abandoned works in 1679; Petit, Helvetius, Deidier,

Regnandot and Lassus were the first and dealt with it fervently: and the illustrious Deidier in 1791 tackled the subject of the plague which brought massacres to Marseille. He injected a dram of pestiferous bile dissolved in two ounces of warm water into the jugulars of the dogs; they became drowsy and sleepy, and died in four hours with gangrenous inflammations. Much thick, black blood was found in the heart; the liver was swollen and the gall bladder was full of green bile. He made a similar injection into the crural veins of other dogs, and they immediately lost the desire to eat and drink; they urinated frequently; and on the third day they had notable tumors under the armpits and in the groins, at a distance of three fingers from the wound which became covered with gangrene. These dogs mostly died on the fourth day with all the symptoms of the plague. The very clear Bichat, who brought immature death to the sciences, in 1800, and Portal, also in the same year, undertook various experiments with injections into the veins, and proved that a few air bubbles rapidly produce death; thus confirming what Hayde knew in 1683.

The tireless Bichat [Bichot] achieved by means of the transfusion of venous blood from a pulmonary vein into the ventricle of the heart, in exchange for arterial blood, to set this viscera in motion in several animals that died suddenly. He drew blood from the jugular of one dog and transfused it at a dose of six ounces into the carotid artery towards the brain of another; the animal immediately became restless, his breathing became more frequent, he became sleepy, his animal life ceased completely (says the author); but the heart continued its movements for another half hour, then ceased and its organic life was extinguished. He repeated the experiment and had the same results.

The illustrious Scheel of Copenhagen undertook transfusions and injections in 1769; introduced four grains of emetic tartar dissolved in half an ounce of distilled water into the jugular of a dog at half past four in the afternoon. The dog was quite lively after the injection, and ate again, although he had already been fed before: half an hour later he appeared nauseated and placidly vomited a large quantity of matter; three quarters of an hour later he vomited again; and after 25 minutes he had the same event again. The first rejected material consisted of food; the second in more digestible matters, and the third had a rather acidic odor. He was melancholy; and sometimes, not very dejected, he rushed around; breathing was not greatly altered; the pulse was more frequent; an hour and a half later the breathing became faster and more sonorous; he immediately lay down. He remained like this through the night; at two o’clock he made strong movements, and the author found him unconscious and with the strongest clonic convulsions in all the muscles; sometimes the attacks were those of the feet and jaws for which reason he was continually as if rabid, biting and slashing and lying stretched out. The pulse was, from what could be understood before the convulsions, intermittent and uneven. At about three o’clock the convulsions gradually became weaker; and a quarter of an hour later his death occurred. The muscles were contracted, the stomach contained only a little green bile; the heart was more than ordinary distended by blood. Nothing extraordinary stood out.

At eleven o'clock he injected twelve grains of emetic tartar dissolved in an ounce of water into the jugular of a snotty but otherwise in good condition, fourteen-day-old horse, twelve grains of emetic tartar dissolved in an ounce of water (about a dram remained in the needle). The pulse, which before the infusion beat 48 times in a minute, after this rose to 55, but was a little smaller. Five minutes later the horse began to move its jaws as if it were chewing. The pulse beat 60 times, and breathing was not noticeably impaired; his eyes were a little downcast; nevertheless he ate with appetite. Three quarters of an hour later he began to tremble all over his body; this tremor lasted for a quarter of an hour: then he lay down, had convulsions in his legs, got up, trembled again throughout his body and especially in his head. The wrist was small; but the pulse could not be counted due to the tremor. About an hour and a half after the injection he had some convulsions in his abdominal muscles; he weakly opened his mouth from which a mucous fluid poured out, while the abdominal muscles contracted spasmodically; the tremor in the other muscles was stronger. At the same time he evacuated, twice natural stereo [*sic*]. Two hours after the injection the

tremor stopped completely, the pulse was small and beat 96 times in one minute: the animal had no appetite until six hours into the evening when the animal ate; the pulse was full and beat 60 times a minute; then little by little all the morbid symptoms ceased and the previous state was re-established.

The industrious Viborg, professor of animal medicine in Copenhagen, began his experiments in 1800 and carried out a large number of injections with various medicinal substances, transfusions and inoculations to test to what extent the horse snot, called in French glanders, and the stuffing (*farcimen equorum*) were contagious, and if they were identical. He distinguished himself among all those who wrote on this subject, established the degrees and activity of the contagion, recognized that the dry malignant snotty matter is not contagious at all, and consequently the clothes and tools, when the material has dried on them, are not contagious, that the disease is only communicated with immediate contact, and that the veterinary population is delirious, believing even the atmosphere to become snotty. But the experiments of the illustrious Dane on the contagious nature of moods require to be repeated in other ways and with greater caution, in order to be able to establish firm maxims. I have repeated the tests, as well as various attempts I have made on the treatment of these diseases; I also exposed the use of antimonials at extraordinary doses to close scrutiny, and I will publish the results shortly.

From what has been said so far, it is not a bad idea to deduce that the blood transfusion was not carried out as it should have been to make it useful, and that much of the bad results must have been attributed to inaccuracy. How come you would find sufficient similarity between the blood of a lamb and that of a man? The different organization of these two beings is enough to assure us of the inconsistency; likewise, injections were mostly instituted either without a true scientific purpose or without the principles and rules of the difficult art of experimenting.

These same direct experiments with greater skill could save many women who are victims of uterine hemorrhages, but one should take the precaution of choosing not a lamb or a calf, but a woman of approximately the same age with approximately similar constitution and morals. Likewise in many other hemorrhages; in consumption, in mania and paralysis, in hydrophobia, in plagues, prodigious help could be provided with blood transfusion; and in some cases with the injections of the remedies. Such experiments should be undertaken in epizootics which, like plagues in man, bring rapid massacres; so also in many other animal ailments.

(GIOVANNI POZZI.)

Physiological research on blood transfusion; by G. F. Diefenbach. [Dieffenbach]

- The author enters into the matter with the exposition of the two ways of practicing transfusion. The first, called immediate transfusion, consists in passing, thanks to an intermediate tube, the blood from an artery of one animal into a vein of another; the second (mediated transfusion) is operated by injecting into a vein, using a squirt or other similar instrument, blood drawn, more or less long ago, from the vessels of an animal. We will not follow Dr. Dieffenbach in the comparative examination of the advantages and disadvantages of these two methods; but we will limit ourselves to saying that this skilled physiologist recognizes very great drawbacks in the first, so that he prefers the second. In this way we will come to the experimental part of his work, the most essential for us.

§. I. *Effects of immediate transfusion on animals exhausted by hemorrhage*.

- The experiments carried out by the author to verify these effects are very numerous; However, he only talks about eleven, given that in the others, which he passes over in silence, some fortuitous circumstances occurred which clearly modified the results and produced the death of the animals on which he operated. Only one of these experiences will be reported by us, in order to enable readers to judge the procedure used by Dr. Dieffenbach.

«Having taken, he says, a little black dog, one of those called *Bichons*, I laid the carotid artery bare, and after having made an incision along its length, let the blood drip, until the animal no longer gave any sign of life; this state of apparent death was preceded by violent convulsions. During nervous accidents, the pupils constricted and dilated alternately, until they remained motionless and widely dilated. While he was uncovering the carotid artery, he opened it and covered the jugular with a tube. A piece of artery, about four inches long, taken from another animal, and placed at each end of a tube, served me to pass into the vein, for one minute, the blood of the carotid artery of another dog nearby of approximately the same height. For 18 seconds in the membranous part of the artificial communication channel, pulsations were felt, quickly becoming less sensitive, which stopped completely at the end of that time. The dog that administered the blood seemed to weaken a little more, and the one that received it, on the other hand, seemed at first to make some attempt to breathe; however the state of the pupils did not change in any way; the heart beat very weakly; it just gave such a kind of dark undulations. Mild rubbing, done on the body with the aim of re-establishing circulation, was of no avail; shortly afterwards the animal died. Having opened the corpse, I found the right cavities of the heart distended by coagulated blood; the left cavities contained half-liquid blood and a less intense color. The lungs were pale and streaked with brown spots; the veins of the lower abdomen, of the liver, of the spleen blocked with black blood, while in the brain there was only a very small quantity».

This experiment was repeated on six other dogs of various species, on two cats, one young, the other old, on an old sheep, on a calf and on a kid. In three dogs, in the young cat and in the kid, it had the same result; that is, the animals perished more or less quickly, when life was gradually restored in the other three dogs, in the old cat, in the sheep and in the calf. Which recovery was always accompanied by deep sighs, by alternating motions of dilation and closure of the pupils, by the involuntary loss of feces and urine, and even sometimes by abundant vomiting. The animals survived the transfusion and recovered their original health after a variable time, from a few hours to three days.

From these facts it can be seen that, with the immediate transfusion, practiced on animals of the same species, reduced to a state of asphyxia very close to death due to the almost total removal of the blood, it is possible, in a large number of cases, to completely restore the exercise of life; result completely in conformity with what Doctors Blundell, Prevost, Dumas and others obtained from their experiences, of whom our author also declares to adopt all the teachings. «There is, however, only one point, he says, on which I cannot entirely agree with their sentiment, and that is that the transfusion is of little danger; I have, on the contrary, often found it fatal, even though no criticism could be made of the way in which the operation was carried out».

§. II. *Effects of mediated transfusion, carried out using a syringe, on animals exhausted by heavy bleeding*.

- Experiences of this kind present fewer difficulties than the previous ones, and require less time; therefore Dr. Dieffenbach established a very large number of them on various species of animals. In his memoirs he reports many of them in detail; but since these are very well-known things, we will pass over them in silence, only to say that they were performed with blood freshly drawn from the vessels and which still retained its heat. The results were the same as those of the previous series: with the only difference that the animals were brought back to life more frequently. Which revivification was less frequent in cats than in dogs, half of which were revived by transfusion and survived; the proportion was even greater in sheep and calves, of which over two-thirds were brought back to life.

§. III. *How long does blood retain the ability to bring a bloodless animal back to life?*

- From the experiments undertaken by Dr. Dieffenbach to resolve this question, and which he does not report, «for the reason, he says, that they did not lead him to results which certainly determine the duration of the vitality of the blood», it seems that this vitality

gradually diminishes, starting from the third hour after its exit from the vessels; that it is more rarely possible to bring animals back to life when blood that has remained exposed for some time outside the vessels is injected; that this revivification is often of very short duration if blood that has been exposed to the action of atmospheric air for more than six hours is used; finally, that an even older blood only awakens very faint signs of life, as would any warm liquid injected into the veins, but it never serves to recall life. Which result does not agree with the assertion of Dr. Blundell, who claims to have resuscitated dogs with blood extracted over twenty-four hours ago. Blood left in contact with air, until it begins to decompose, acts on the organism in absolutely the same way as other putrid liquids, the effects of which Dr. Gaspard has so well described.

§. IV. *Can dried blood put back into the water serve to bring one back to life?*
- From experiments carried out by injecting into the veins of animals exhausted by heavy bleeding, dried blood, removed from their own species, then dissolved in warm water, the result was sometimes some signs of life, never the perfect revival of the animal.

§. V. *Effects of transfusion of one animal's blood on other animals of different species.*
- Dr. Dieffenbach has undertaken a long series of experiments on this interesting point, already treated by Prevost, Dumas and Blundell, but in an imperfect way, in the author's opinion. «I have never succeeded, he says, in reviving an animal with the blood of animals of different species. Some dogs were, it is true, shaken from the state of apparent death, thanks to the mediated transfusion of sheep's or man's blood; but the greater number died quickly from violent convulsions, chiefly when human blood had been used. None of these animals survived the sixth day. However, it seems that other experimenters were luckier than me. Dr. Blundell, among others, claims to have revived a dog by injecting blood taken from a man, and that the animal survived this experience. As for me, despite all the precautions imaginable, the experiment never worked». In order to verify the different degrees of action of a foreign blood, the author in the experiments we are talking about, left to the animals only a part of their own, and replaced a quantity, now smaller, now larger, of the blood of a animal of different species.

A. *Transfusion of human blood into a cat*.
- Three ounces of blood were extracted from the jugular of an adult cat, which were replaced by two ounces of the same liquid taken from a gouty man; the injection was made so slowly into the animal's vein that not more than one dram could reach the heart in twenty seconds. As soon as the first three drams were injected, very high-pitched cries of pain, a deep sigh, an acceleration of the pulses and breathing, as the quantity of blood injected increased, the difficulty in breathing became even greater; the animal died immediately upon introducing the last drop of blood into the vein, after some violent but non-convulsive movements. When the corpse was opened, all the organs were engorged with black, coagulated blood, especially the kidneys, the spleen, the liver and the right cavities of the heart. The cerebrum and cerebellum were also heavily injected; at the base of the skull, there was a bloody extravasation about half an inch in diameter.

B. *Transfusion of ox blood*.
1°: *In a ram*
- About forty ounces of blood from a freshly killed ox were injected, in four stages, leaving an interval of about two minutes between each injection, into the jugular vein of a large ram which had not previously been bled. The animal remained calm during the entire operation; he only ground his teeth several times, and had a great fullness of pulse. Released at the end of the experience, he walked at a slow pace with his head down; After all, he didn't seem to suffer from any other inconvenience. A few hours later he was killed; having

examined the corpse, nothing notable was found, with the exception of a very great repletion of the cavities of the heart and of all the blood vessels.

2°: *Ox blood injected into dogs*
- Having bled a dog to the point of fainting (he drew about a pound of blood), he was instantly injected with an ounce and a half of ox blood which had remained in contact with the air for forty hours. Immediately, breathing and circulation accelerate; but not very close to the natural rhythm. The animal makes some moans; the pupils dilate enormously, and at the end of a quarter of an hour, when the experience is over, the state of the animal is what one would have expected from a prompt death: however, after three hours, it appeared noticeably improved, and within a few days was fully recovered.

The experiment was repeated on the same animal, with this difference, that only an ounce and a half of blood was extracted from the jugular, a quantity which was replaced by blood from an ox killed twenty-four hours ago. The incidents were completely identical with those noted in previous cases; with the only difference that they were much more violent, and towards the end of the experiment, the animal, having fallen into a sort of stupor, retained all the positions to which it settled into. He lasted in this state for a good eight hours; the following morning he was found dead. The examination of the corpse showed the vessels of the brain and the right cavities of the heart distended with black and coagulated blood.

A third experiment of the same kind was attempted on another young and vigorous dog. Having removed a pound and a half of blood from his jugular, from which he seemed to suffer almost no point of weakness, he was injected, dram by dram, in four installments, with an interval of two minutes between each one, half an ounce of ox blood kept in the air for twenty-four hours, and which had not allowed itself to be congealed by agitation; this blood was also passed through a napkin and heated to a suitable degree. The injection was done very slowly, so that it took a good two minutes for each dram of liquid. The results of this experiment differed very little from those of the previous one; at the end of the operation, the animal lay collapsed on the ground, motionless and struck by such perfect insensibility that announced very close death. He, no less, a few moments later, made a lot of clear and almost odorless urine, and the signs of life became more perceptible. After a few seconds, the animal recovered to the point of raising its head. It lasted in this state, without notable changes, for about six hours, at the end of which it succumbed.

C. *Transfusion of rabbit blood into a cat*.
- An equal dose of venous blood, recently extracted from a young rabbit, was injected into the jugular of a five-week-old cat, which had initially had a dram of blood removed. About one minute after the operation, rapid breathing, cries of pain, convulsions, back thrown backwards; at the end of a minute, perfect calm, which lasts for fifteen seconds, then the animal drags itself along the ground in a circular motion, using only its front legs. After twelve minutes, violent trembling in all the limbs followed by a general and very great dejection. The animal has no appetite for three days, its belly is swollen and its heat is considerably reduced; he finally dies on the morning of the fourth day. All the internal organs are pale and brittle, the intestinal canal distended by gas, and its internal membrane very pale, as are the cerebrum and cerebellum. The heart contains only a few drops of brownish blood.

D. *Pig blood transfusion*.
1°: *In cats*.
- Into the jugular of an adult cat the author injects three drams of pig's blood, which had remained in contact with the air for twenty-four hours. After two minutes, rapid breathing and the other symptoms indicated in the previous cases; which however, calm down towards the fourth minute. Half an hour after the operation, abundant vomiting and blackish, fetid

discharges: after six hours, a very evident feverish state: the next day all the incidents cease and the animal gradually recovers.

This experiment repeated on another cat about six weeks old, gave approximately the same results; the animal recovered following abundant and fetid evacuations from the anus and the mercy of vomiting. The quantity of blood used was three drams, and was kept liquid by agitation.

2°: *In a dog*.
- Having drawn six ounces of blood from a dog of a strong breed, six weeks old (from which only slight weakness arose) Dr. Dieffenbach, in the course of ten minutes injected three drams of pig's blood, stored in the air for twenty-four hours. The accidents did not begin until the fifth minute, and were visibly less violent than in previous experiments. The following morning the animal was perfectly recovered.

E. *Transfusion of calf blood into a cat*.
- Having extracted about an ounce of blood from the jugular of a young cat, the same quantity of calf's blood was injected in its place, left in the air for twenty-four hours, passed through a napkin and duly heated. The injection was pushed towards the heart; instantly, very painful breathing, shouting, extreme weakness and profound syncope. A scruple of the same blood was then introduced into the vein towards the brain; suddenly, the animal came out of the state of apparent death, rolled on the ground, and, after a few moments, it seemed life was extinguished. Then the belly and chest are opened; the heart tightened slowly and weakly. Half a scruple of the same blood was now injected into the iliac vein, pushing the injection towards the heart; which organ suddenly began to move with more force at the same time that respiration gained strength. The same phenomenon occurred after the injection of the same quantity of blood into the descending aorta and pushed towards the heart: except that after a few moments, all signs of life went out. From these and many other experiences, which he does not report, Dr. Dieffenbach concludes that: 1°: blood preserved for some time, kept liquid by stirring, then passed through a napkin and injected into the veins of an animal of different species, is readily fatal; 2°: extensive bloodletting to the point of syncope can reduce the harmful influence of foreign blood stripped of its own vitality due to too long contact with the atmosphere; 3°: the injection of a certain quantity of foreign blood, which has remained exposed to the air for a long time, and which, without previous bloodletting, would be sufficient to kill an animal, does not give this result, as long as one begins by removing a considerable quantity from the animal of his own blood.

§. VI. *Can blood communicate diseases through transfusion?*
- Dr. Dieffenbach holds the affirmative, supported by a large number of experiences of which here are the main ones.

A. *Transfusion of blood from leprous cats into healthy cats.*
- In the period of six minutes the author injected into the jugular of a very lively young cat, not prepared for the experiment by previous emission of blood, two and a half drams of fresh and warm blood, extracted from the ventricles of the heart of a leprous cat, which he was killed by injecting chicken blood: after a few seconds, acceleration of heartbeat and breathing followed by extreme restlessness; but it doesn't take half a minute for calm to return. At the end of the sixth minute, it seems that the animal feels nothing but supreme dejection. Released, he did not suffer from any accident, or offered any trace of skin disease during the course of the six months which the author kept him alive. Repeating this experiment on another cat, with three drams of blood collected from incisions made on the skin of a leprous cat, the same result was obtained with respect to the skin disease. At which Dr. Dieffenbach believes he should be all the more astonished since cat leprosy is a

highly contagious disease: in fact, the old cat, from which he had removed the blood used for injection, had infected all the other cats in the neighborhood.

B. *Transfusion of blood from horses with scabies and snot into healthy horses.*
- From the carotid artery of a snotty horse attacked by skin scabies, around seven pounds of blood was passed directly into the jugular of an old healthy horse, at the same time that five pounds of his own blood was being taken from the other jugular. During the operation, which lasted about ten minutes, the same phenomena noted in the experiments mentioned in the previous item were noticed. Shortly afterwards, the horse developed emphysema over the entire surface of the body, which was less than a fifth of, due to the appearance of a large number of hard buttons all over the skin; on the seventh, no trace of emphysema remained. By the twenty-seventh, the scabies had fully developed. After cutting the animal's body, a few days later, all the characteristic alterations of this disease were found in the organs. In another healthy horse, the author transfused five pounds of blood, using the syringe. The operation lasted ten minutes, and was not preceded by the extraction of the animal's own blood. In the first minutes, in addition to the phenomena already mentioned, there was a notable increase in temperature and symptoms of dizziness. The animal remained in pain, and died on the eighth day, probably, says the author, due to fullness of the entire vascular system; since, when the corpse was cut, all the parts were found in a natural state.

§. VII. *Experiments tending to produce extravasations in the brain by injecting blood into the carotid arteries.*
- Dr. Dieffenbach did not believe that it was possible to produce spills in the brain with moderate injections of blood; but he suspected that a violent injection would cause blood to come out of the little vessels; indeed, that large vessels would have broken if greater force were used. The following experiment was undertaken with the object of clarifying his ideas on this subject. Forty-five ounces of venous blood from one horse was injected into the right carotid artery of another horse, forcefully pushing the fluid toward the brain. The experiment lasted a quarter of an hour, and in this time eighteen injections were given. Towards the end of the experiment, the animal fell on its left side, breathing became stertorous, the eyes closed, and the pupils dilated widely, so that all the symptoms of a violent attack of apoplexy appeared. Wanting to know more precisely the results of this experiment, he cut off his head; and to the author's amazement, no trace of blood extravasation, nor of any other noticeable alteration was found in the brain; the right side offered no noticeable difference from the left side: the organs of the chest and lower abdomen received proportionately more blood than the brain.

§. VIII. *Transfusion of blood from cold-blooded animals into mammals. – Injection into a cat*
1°: *Of tortoise blood*. - Two drams of fresh blood from a European tortoise were injected into the vein of a young cat. A few minutes passed before the cat was seized by violent convulsions; which, however, calmed down little by little: the pupils, at first very dilated, soon became very narrow; wheezing; very fast pulses; lower abdomen enormously swollen. These incidents ceased after five minutes, and were followed by a state analogous to syncope which lasted for a few hours; the animal subsequently emitted a large quantity of red urine, and on the morning of the following day he showed that he was fully recovered.

2°: *Of fish blood*. - One and a half drams of fresh carp blood, diluted in half a dram of water, and passed through a napkin, was injected into the jugular of a cat, from which two drachms of blood had previously been extracted. The operation lasted half a minute. At the end of twenty minutes, the animal died between violent convulsions. The two ventricles of the heart contained liquid blood. Many other experiments carried out on dogs, cats and rabbits with the blood of carp, pike and eel always resulted in the death of the animals in the midst of

violent convulsions; except when the amount of blood injected was comparatively very small. From all these experiments Dr. Dieffenbach concludes that the blood of cold-blooded animals is neither effective in reviving nor in maintaining the life of mammals; on the contrary, this blood is of great harm to them.

§. IX. *Transfusion in birds*.
- All these experiments were followed by death. Large numbers of pigeons, hens, ducks, geese, crows and the like, from which the author had drained all the blood, to replace them with fresh blood of birds of the same species were not brought back to life at all. Having cut up the corpses of all these animals, he found the right heart, filled with liquid blood and some clots, and in the left ventricle, either small clots or a little liquid blood. The lungs had some rust colored spots here and there. By taking away from the birds only a certain quantity of blood, and in its place injecting an equal quantity of blood taken from an animal of the same species, and stripped, by means of filtration, of almost all its fibrin, no serious accidents occurred unless the quantity injected exceeded a dram. The animals which did not perish immediately amidst the convulsions which occurred did not subsequently experience any accident.

§. X. *Transfusion of mammalian blood into birds*.
- A very singular phenomenon is seeing how from very little mammal blood injected into the veins of a bird, the almost instantaneous death of the later results, which falls to the ground, as if a large dose of hydrocyanic acid had been injected into it. The song birds die most quickly; waterfowl resist for much longer: a few drops of blood from a mammal are enough to kill a pigeon; to kill a goose requires between thirty and forty drops of ox, sheep or pig blood. These results agree with those obtained from similar experiments carried out by doctors Prévost and Dumas. The author believes that blood has an action on the nervous system of birds similar to that of narcotic poisons.

§. XI. *Injection of the blood of cold-blooded animals into birds.*
- This type of injection is equally fatal to birds, even if it occurs in very small quantities: nevertheless, death is less rapid and the accidents by which it is accompanied are less violent.

§. XII. *Injection of blood collected from capillary vessels*.
- Dr. Dieffenbach found that the blood of mammals extracted from the capillary vessels by means of scarified suckers and injected into the veins of birds caused them to die immediately in violent convulsions, like the blood drawn from the large vessels: however, that which is squeezed from leeches engorged with human or mammal blood, seems to have lost much of its action on the animals into whose veins it is injected; indeed in birds, which are the most sensitive to this action, an abundant injection of this liquid extracted from the leeches is required, to produce death with the speed and violence with which it follows the other processes.

§. XIII. *Is blood serum capable of bringing bloodless animals back to life?*
- The negative is proven by Blundell's experiments and confirmed by those of Dr. Dieffenbach.

§. XIV. *Does fibrin have the property of calling to life?*
- From the experiments attempted by the author on this subject, it appears that a drop of fibrin dissolved in half an ounce of water, with a small dose of caustic soda, and passed through a napkin, has indeed produced in a dog, which had lost everything its own blood, very slight contractions of the heart, but it did not bring the animal back to life.

§. XV. *Effects of the injection of the heart.*
- Wishing to know whether the effects of transfusion were due to the blood alone, or to the blood combined with the other parts constituting the blood, the author injected blood diluted in a certain quantity of water into various animals and obtained the same results as those obtained from blood not deprived of any of its constituent parts. Mammals succumbed to the injection of a large quantity of bird blood, and the same occurred suddenly and with even more serious nervous accidents when mammalian blood was injected into the veins of a bird. Water containing suspended chemicals, and left in the air for a long time, gradually lost its influence, and subsequently produced only phenomena similar to those which result from the injection of a liquid not endowed with special action.

From all these experiences Dr. Dieffenbach draws the following conclusions: 1°: a bled animal may be brought back to life by injections of blood from an animal of its own species and may continue to enjoy full health. 2°: Blood taken from animals of different species can sometimes show signs of revival but never preserve life. 3°: If, to carry out the transfusion, blood from an animal of a very different species is used, death always results even when the quantity injected is very small. 4°: Preceding bloodletting before injection makes mammals less sensitive to the deleterious action of the blood of birds or cold-blooded animals. 5°: The injection of the blood of mammals or fish always causes birds to die, and death is always accompanied by the accidents which narcotic poisons usually produce. 6°: If, after the injection of foreign blood, abundant evacuations occur due to vomiting, secess or urine, this type of crisis ordinarily diminishes the animal's danger. 7°: Blood exposed for a long time to contact with atmospheric air does not lose its reviving properties until it begins to break down; however, once it has become putrid, it produces the effects of any other putrefied animal substance. 8°: Age, sex and various body conditions do not vary the action of the transfused blood. 9°: Transfusion does not always transmit diseases. 10°: Venous blood is the most suitable for this operation. 11°: Transfusion, even if done with animal blood of the same species, is always dangerous, indeed more dangerous than some physiologists have believed. Compared to using it as a remedy, this operation seems indicated in cases of imminent death due to hemorrhage, and only when all the other aids of the art have been rendered useless: however, it is never necessary to use anything other than human venous blood. The author believes that blood transfusion in hydrophobia is of no benefit. (Rust's, Magazin für die gesammte Heilkunde, XXX, Bd 1829)

Uterine blood loss rebellious to any aid cured with transfusion.
- A 28-year-old lady, married at the age of 19, of very delicate texture, who gave birth to four children, and had two miscarriages, left the puerperium in September 1832, came on 26 April 1833 suffering from menorrhagia, for which her vagina was filled with many pieces of coagulated blood which stopped the loss for a few moments. Thus up to the 30th day the hemorrhage occurred at intervals, and it was on this day that doctor Banner of Liverpool examined her for the first time. The pulse was not regular, the tongue was not clean, the skin was warm, the thirst was mild, the bowel movements were normal, she was not experiencing any sense of pain in her lower abdomen. Red blood continually dripped from the vagina, and the patient continued to attend to her domestic chores without causing any change whatsoever to her usual way of living. She was prescribed a mixture of one dram of sulphate of magnesia, eleven ounces of rose infusion and five drops of diluted sulfuric acid, to be consumed in spoonfuls. On May 1st the bleeding had almost stopped and the patient had multiple bowel movements. On the 2nd day she felt so good that she resumed her domestic chores in full; but as a result of this early exercise the hemorrhage recurred with such force that blood clots of enormous size came out of the vagina, one of these weighing six ounces. Rest and cold lotions slowed its progress, but it soon reappeared with greater vehemence. In spite of the ice, the liquid laudanum, the ergot, the alum, the frozen injections and the corks introduced into the vagina, the patient falls into such a state of

exhaustion that her pulses can barely be felt from time to time: breathing became very slow and almost insensitive, the semi-closed eyes took on a glassy appearance, urine flowed involuntarily, and hiccups from time to time hinted at their existence. In this extreme state, Doctor Banner resorted to the operation of transfusion, using Blundell's apparatus, and benefiting from the blood taken from the patient's husband's arm. Having introduced so much blood into the vein of the patient's right arm, as much as the small pump of the device could contain five times, her breathing became so difficult that it was necessary to suspend the operation. But after a few minutes of rest, two more pumps full of blood were introduced again: the anxiety then became greater, the pulse became disordered and barely perceptible, and the patient showed no sign of feeling. The apparatus was removed, and the small wound made at the bend of the arm was dressed, in order to expose the vein for three-quarters of an inch, in order to inject the husband's blood into it. For a good three hours after the transfusion was completed, the wrists remained barely sensitive, the body remained cold and covered in winey sweat, and the patient seemed dead. But later the pulse gradually developed in her wrists, her breathing became more regular, and she was able to swallow a few small spoonfuls of brandy diluted with plain water. If she took more, she would soon be attacked by hiccups and anxiety. From that time the symptomatic system became more favorable although the appearance of the phenomena changed from hour to hour, being now agitated, now insensitive, now with fast and strong pulses, now without pulses. We moved on to the use of soda water for cold drinks and port wine. On the 9th day the patient improved, and on the 10th she developed a discharge of fetid matter from the vagina. There was also urine retention probably induced by the compression exerted by the cork on the neck of the bladder, so it was necessary to have recourse to the catheter which extracted good colored urine. On that day the pulse of the operated arm gave 110 beats: whereas only 90 beats could be felt in the other arm. The belly was kept open with castor oil; and through a nutritious tonic diet she gradually gained strength so that she could get out of bed on the 14th day after the operation; and on the 21st she left for the countryside.

This observation considered in several ways is undoubtedly important. In particular, it can be seen that the beneficial effect of the transfusion did not appear immediately, as would have been expected. If the precordial seniority had not been caused by this operation, it could have been deduced that such an operation had not exerted the slightest influence on the animal economy since for a few hours the pulses remained barely sensitive and the patient found herself weakened more than before. It was not possible to calculate exactly the quantity of blood injected: the pump, which could contain approximately two ounces, was empty six or seven times. However, there seems no doubt that this blood contributed to maintaining vitality in an organism that was about to be extinguished. The quantity of blood introduced was small when breathing became laborious; phenomenon perhaps also to be repeated by the quality of the injected blood, since it was obtained from the arm vein of a strong and plethoric man. It would therefore probably have been possible to introduce a greater quantity if it had been obtained from an individual whose organic constitution was similar to that of the sick person.
(The London Medical and Surgical journal, junii 1833)

Dr. Berg's blood transfusion case.
- A woman of 39 years of age, frail in limbs, but of tall stature, after having happily given birth for the ninth time, suffered intercurrent uterine hemorrhages for about ten days after giving birth, which she dealt with by rest; when, without any obvious cause, around noon on the tenth day, a new hemorrhage broke out, which within five hours had brought the woman to a very sad state, who, pale in face and exhausted of strength, could barely make her words heard; she had difficulty breathing, a small, frequent pulse, dilated pupils, nausea and vomiting. Having tried in vain all means to overcome the atony of the uterus, to which metrorrhagia was attributed, and which arose around eight hours in the evening, although the blood loss had stopped, frequent fainting spells, incessant hiccups, an icy cold in the

extremities, with increasingly difficult and interrupted breathing, and a barely sensitive pulse, Doctor Berg of Jugelfingen, without further hesitation, advised to resort to the transfusion, which was immediately carried out following the teachings of Dieffenbach; that is, injecting two and a half ounces of blood supplied by a healthy man present at the operation into the basilic vein of the left arm. The patient remained unconscious for a few more minutes, but shortly thereafter her breathing became deeper and less interrupted and her pulse more sensitive. After eight minutes, she reopened her eyes and answered questions accurately. The sick woman knew nothing about the painful operation. The metrorrhagia did not reappear, and after four weeks the woman found herself perfectly recovered.

According to Dr. Berg, this case is to be added to the two similar cases disclosed by Dr. Klett, as they tend to demonstrate that a small quantity of blood is sufficient to achieve the effect; which cannot be clarified otherwise than by admitting a particular dynamic power in the blood. (*Medizinisches correspondenz. blatt des Würtembergischen arztlichen Vercinis herausgegeb. von den D. D. Blum-Hardt. Duvernoy und Seeger 1838, Nr. 2*)