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THE VALUE

*Don't strip this cover*

OF

TRANSFUSION OF BLOOD.

*Pres by A.E. M. Purdy*

BY

FREDERIC D. LENTE, M. D.,

COLD SPRING, NEW YORK.

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In this paper it is my purpose mainly to review the remarks of Dr. Fordyce Barker, made at a meeting of the New York Academy of Medicine in January last, and reported, with the discussion thereon, in the "Medical Record" of April 1, but also to refer to the *relative* value of other methods for saving life when rapidly ebbing from exhaustion produced by hæmorrhage, shock, etc.

From the time when Sir Christopher Wren and Dr. Lower commenced their experiments, more than two hundred years ago, to the present time, the subject has attracted but a moderate share of attention from the Profession until quite recently; and although a variety of ingenious instruments have been contrived, from time to time, and the operation somewhat simplified, and some brilliant results obtained, the process has never become at all popularized in the Profession, and success certainly,

so far as modern operators are concerned, has not been commensurate with the expectations of its projectors and cultivators.\*

Dr. Barker relates a successful case occurring in 1666. A large number, about seventy, successful cases have been reported from that time to the present, to which the Doctor alludes, but a much larger number of unsuccessful cases. Now, if we analyze the *successful* cases, as Dr. Barker presents them, we find, in the first place, with a larger experience in the operation, and with better apparatus, it has been, if anything, less successful latterly than formerly; that, in the unsuccessful cases, especially those performed in this city, it has been performed by, or under the direction of, our most eminent men, as Thomas, Van Buren, Flint, Jr. Dr. Braxton Hicks performed it in Guy's Hospital six times, all unsuccessful. Six cases in New York City, all unsuccessful. Nor will it avail to say that the fatal result was attributable, in those cases, to *thrombosis*; as, with such operators, due care would be taken to prevent this; and, moreover, in almost every case an improvement, lasting some hours, followed. Again, it will be noted that in almost all the successful cases, when the cause of exhaustion is mentioned, it is *post partum* hæmorrhage, or that following abortion, as Belina's seven successful cases, and ten of Dr. Higginson's successful cases. Now, all who have had a large obstetric experience are aware of what incredible quantities of blood a woman may, with impunity, lose under these circumstances, and must also have noted the extraordinarily rapid convalescence after these losses, provided full nutrition is maintained. I have seen these patients again and again lying pulseless, exsanguined, blind, respiration irregular and sighing, vomiting the anodynes and stimulants vainly given, and yet I never had the ill fortune to see one die, though we did not then possess the means which

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\* Dr. Jos. W. Howe informs us that transfusion "was brought fully into public notice during the latter part of the fifteenth century by the physician of Pope Innocence VIII., who sacrificed three young boys in performing the operation on his master. The transfusion was made with instruments resembling those used at the present day."

we now do for averting a fatal result ; as, for example, hypodermic injection.

Then, if we examine Deny's two cases, occurring in 1666, so successful that all France was crazy on the subject, and so many fatal results occurred from the operation, as we are informed by Dr. Barker, that it was interdicted by law. I say, if we examine his cases, we will see that, desperate as they undoubtedly appear to have been, they are just such cases as might have been relieved by other methods, which will presently be alluded to.

But I will first relate a case in point. Six years ago I was summoned to see a lady of wealth and refinement, young and beautiful, married a few years, but separated from her husband at the time from some domestic discord. Not appreciating the urgency of the call, I delayed perhaps half an hour ; and on my way met a messenger on horseback, who said the lady was dying or dead. On reaching the room, I found the patient lying across the foot of the bed, where she had fallen, in a state of profound syncope, on endeavoring to get into bed. Her complexion, usually very brilliant, was blanched ; she was completely unconscious, and her pulse at the wrist gone. She had had repeated attacks of menorrhagia, and had ceased to dread them, and so, this time, had allowed herself to go on, day after day, losing blood, until a sudden profuse gush induced the alarming condition in which I found her. I immediately tamponed the vagina to prevent further loss, ordered enemata of brandy and Liebig's extract of beef, and sent a messenger for my friend, the late Professor Elliot, who happened in the neighborhood. She was, after great exertion, slightly rallied ; but we both wished for some reliable means of transfusion, but being several miles in the country, we had none. However, we sent a telegram to Professor Flint, Jr., who had just imported an excellent French instrument. Dr. Flint remained with us all night, but the occasion for resorting to the operation did not occur. For twenty-four hours, however, it was unsafe to change her position across the bed, and her recovery was exceedingly protracted. But she did ultimately entirely recover.

Again, in many of the cases reported as successful, only a few ounces of blood (in some instances two or three) were used; whereas, in some of the unsuccessful cases, a considerable quantity, thirteen to sixteen ounces, in one case nineteen, were injected, but introduced slowly and with sufficient care, each fresh application producing temporary amendment. Now, as Austin Flint, Jr., remarks: "Normally, the patient should have from fourteen to eighteen *pounds* of blood *circulating* in the system to properly *sustain* (the italics are mine) the functions of the body." Is it, therefore, reasonable to suppose that from two to eight ounces, the amount usually employed in transfusion, should do more than *temporarily* excite the action of the heart? In his remarks before the Academy, on Dr. Barker's essay, he asks the question: "What seems to be the mechanism of the influence by which comparatively small quantities of blood, introduced into the circulation of a person dying either from hæmorrhage or from exhausting disease, produces such restorative results?" But he is not reported as having answered the query.

From the results of injections of *solutions of salts* in cholera and other diseases attended by exhausting discharges, which were, at one time, largely and enthusiastically employed, it would seem as if the *modus operandi* is mechanical, as a general rule; giving to the heart and large vessels more to take hold of and to act on, and thus stimulating them. Wonderful, though temporary results have followed these injections, more so, as a general rule, than from the use of blood, apparently because of *the larger quantity*. In this connection, I refer to a most remarkable paper in the "London Practitioner" for January, 1873, on the injection of *pure milk* into the veins, by Dr. Edward M. Hodder, of Toronto. Basing his action on a knowledge of the experiments of Donné, and on the opinions of Wagner, Gulliver, and others, that the corpuscles of milk are capable of alteration into blood corpuscles, he injected fourteen and twenty-eight ounces of milk, in a few hours, into the veins of two patients *moribund* from cholera, with immediate relief and

subsequent cure. In a third case, the first injection of fourteen ounces produced great relief, but a relapse occurring during his absence, he lost his case, as he thinks, from the want of a second injection.

Dr. Anstie adds a *note* in which he says: "We scarcely know whether it is necessary to add, even for the information of English readers, that Dr. Hodder is a very distinguished and experienced practitioner, so that his evidence is most valuable and trustworthy."

I will only add, in this connection, that, so far as our past experience extends, it appears that, to be really successful in any considerable number of cases, and where success would not be attained by the *vis vitæ*, or through more acceptable measures, the experiments need to be carried further, and the injections repeated in regular doses, as the effect of the preceding is seen to be passing off, just as we would use any other remedy. But, here the difficulty presents itself, the want of *material*; and, on this account, if on no other, the experiments of Dr. Hodder deserve a further trial.

As regards the use of transfusion of blood in blood-poisoning, alluded to by Dr. Lusk in the discussion, further experiments are also needed to determine whether here the results may not be more permanent, as they have been in one or two cases.

In making the above comments on this discussion, and on Dr. Barker's remarks, it is far from my intention to depreciate any of the wonderful triumphs of modern medicine in the alleviation of pain and the saving of life; no one glories more in them. And transfusion may be ranked among the great triumphs, if it has rescued one life otherwise irrecoverable, and it has, without question, rescued many. But the treatment will be more successful if it is placed on its proper basis, limited to its appropriate applications, and assisted by auxiliary measures, to which I shall presently allude. Two or three brief cases, in addition to the one already adduced, will illustrate the results of the treatment by which we may supplement or assist the operation of transfusion of blood.

CASE I.—L. S., a man 46 years of age, exhausted by long continued strumous suppuration of the ankle joint, and tottering on the verge of the grave, came under my notice in this condition, and amputation of the leg was advised as a "forlorn hope." It was done with the aid of my regular assistant, Dr. Bluxome, now of San Francisco, and the late Frederick G. Le Roy, M. D., of Tarrytown. He lost a great deal of venous blood, and he was pulseless and *in articulo mortis* for some time. Injections of brandy with beef-tea *per rectum* were regularly given him by Dr. B. and myself, and it was only by constant personal attendance, for forty-eight hours, on our part, that he rallied. He is now quite well.

CASE II.—B. S., a girl sixteen years old, lost all the integument from arm and forearm from a kerosene burn. Profuse hæmorrhagic granulations formed, after a time, over these parts; and, for months, she continued in this state, suffering agony at each dressing, and often requiring anaesthesia to enable her to bear the dressing, but still refusing amputation. Finally, worn out by suffering, she consented, and I removed the arm at the shoulder-joint, with the aid of my regular assistant, Dr. Richardson, and John F. Hammond, M. D., U. S. Army. The arteries were of course much enlarged by long continued inflammation and exuberant growths, and also a much larger number of smaller vessels than usual required ligature. Added to this, the pressure on the subclavian seemed to exert little or no control over the circulation; so with scant assistance, and under such circumstances, a large amount of blood was necessarily lost, and the girl was completely exhausted, insensible, and pulseless. The same routine of treatment as in the last case, continued for several days, resulted in rescuing the patient, and she is now able to support herself. My colleague at the Hudson-River State Hospital, Dr. Kellogg, related a similar case to me to-day, of which he had charge at the Utica Asylum. A patient, in the sitting posture, opened the veins at the elbows of both sides, and lost an enormous amount of blood; she was insensible and pulseless. Dr. Cleave-

land and he worked diligently for twenty-four hours, with ordinary remedies, elevation of the foot of the bed, warmth to surface, stimulants by mouth and rectum, bandaging the extremities, etc., and the patient survived. I will only tax your patience with the brief history of one more case of this kind, which occurred quite recently, though I might go on multiplying them almost indefinitely.

A fortnight ago, while attending a case in Newburgh, in consultation, it happened that my friend, Dr. S. Ely, of that city, was in the midst of a most serious operation, and hearing of my propinquity, kindly sent for me. The case was a recurrent fibroid tumor of the posterior aspect of thigh, which he had twice before extirpated. The condition of the patient, a female, was very feeble when he commenced. She refused to entertain the idea of amputation. He prepared the limb after the manner of Esmarch, and with perfect success. For, during the extirpation, although as it appeared, on subsequent dissection of the limb, all the large vessels, including the femoral, were divided, there was absolutely no hæmorrhage. My advent on the scene was just after the constricting cord had been removed, and a furious gush of arterial blood from numerous vessels, much enlarged, warned the Doctor to reapply the rubber cord. Amputation was now the only hope, and a forlorn one. The pulse was flickering at the wrist, and very slow and compressible at Poupart's ligament. At the request of Dr. Ely I compressed the artery at this point; and he rapidly removed the limb at its upper third by the circular method. Just previous to this, however, I suggested the precaution of injecting a stimulant *per rectum*, as she was insensible from exhaustion and the anæsthetic, and Dr. Ely injected half a tumblerful of undiluted brandy. Notwithstanding the compressibility of the artery and my care in keeping up a steady pressure, for some reason, blood poured out freely from numerous vessels, and although they were secured with great skill and celerity, a very considerable loss of blood occurred, and the pulse became quite imperceptible. Within half an hour a tumblerful and a half of

brandy undiluted was given by the rectum and retained. She was pulseless at the wrist for half an hour, and considered quite hopeless by more than one of the physicians present. I remarked to Dr. Ely, "here is a case for transfusion." She was put to bed, covered warmly, had bottles and jugs of hot water placed about her body and extremities. I saw the patient two days afterwards, and she was slowly rallying. Within the last few days I received a letter from Dr. Ely, in which he says: "She has been steadily improving in strength, the pulse at first imperceptible, gaining in force and frequency. Stump doing well. I think, therefore, that a favorable prognosis may be entertained." In this case the feeble cardiac action was due partly to shock, partly to hæmorrhage, as is commonly the case in surgical operations.

There are certain cases undoubtedly, though exceptional, in which nothing short of transfusion, and the transfusion of blood alone will meet the indications presented. Such a case as this, which I saw several years ago in consultation with two surgeons of the army. A lady, the wife of an officer had been delivered of twins, had lost a large amount of blood *post-partum*, and had continued to lose blood for three weeks, up to the date of my visit. She was blanched to the last degree; her appearance was indeed striking—more ghost-like than anything I had ever witnessed. The hæmorrhage had ceased just previous to my visit, and did not recur. But, although she took a large quantity of the most nutritious food and stimulants, she pined slowly away and died. It will always be to me a source of regret that we did not practice transfusion.

Dr. Fryer, of the U. S. Army, in an interesting article in the last number of the "Medical Record," so well describes these cases that I quote his words: "Of the acute cases we refer to, those in which natural nutrition is, for the time, suspended, either from direct lesion of the blood-making system, in one or more of its divisions, or is indirectly affected in consequence of some profound systemic impression; where, if we can bridge over a short period by keeping life's machinery going,

we may ultimately bring about a restoration of the healthy nutritive process and thus save life." In most of the cases, however, which he proceeds to particularize, I can not agree that transfusion is necessary, provided we adopt and carry out faithfully and systematically the means here proposed, attending to the details ourselves as strictly as we should in transfusion, or at least superintending them. In some of his gastric cases, for instance, the prohibition of all food by the mouth, for days together, except small and regular doses of lime-water and milk; sometimes even prohibiting this, and making the rectum do the duty of the stomach; sometimes the regulated use of *raw* meat; and latterly, and more important than all, the use of *induced electricity* have enabled me to restore the apparently most hopeless of these cases to life and health.

Among the auxiliary measures to be adopted in aid of transfusion, or as a substitute for it, we may enumerate the maintenance of the warmth of the surface, the liberal supply of pure air, the elevation of the foot of the bed, the methodical bandaging (better with Esmarch's rubber bandage) of the extremities, forcing a large amount of blood from the surface to supply the viscera, digitalis to stimulate the heart; but, above all, a firm faith in the efficacy of soluble beef with stimulants per rectum is requisite, or else its employment, with that supervision, precision, and perseverance which are absolutely essential to success, will not likely be carried out. There is a singular distrust in the minds of the laity and of the Profession to a very considerable extent regarding the efficacy of beef-tea, and especially of Liebig's extract and similar preparations. I say singular, because it is so easy to put the matter, and a very important matter it is, to the test. One case, such as I now adduce, ought to be sufficient. One of my own children, when about five years of age, had scarlatina complicated by diphtheria, then articular rheumatism, then a low fever allied to typhus, with a tongue perfectly dry and brown, with complete inability to retain anything solid or fluid on the stomach. Systematic injections, per rectum, of regulated quantities of beef-

tea and brandy every two hours, day and night, were resorted to and continued for over two weeks before I could venture to rely on the stomach. There were some anomalies in the case, and uncertainty as to diagnosis, which induced me to seek counsel, and Dr. Alonzo Clark, of New York, kindly saw the case with me.

I will conclude this portion of my paper by a reference to one more case occurring in my practice. A maiden lady of uncertain age, bed-ridden for ten years from the *effects* of chronic dysentery and dyspepsia, became the subject of femoral hernia, which, in time, became strangulated, and could not be reduced by taxis. Operation was strongly urged day after day; but as the symptoms were not felt by herself to be very urgent, it was declined. Finally, in the middle of the sixth night, the situation became so desperate that I was hurriedly summoned to perform the operation. Her almost incessant vomiting and her previous bad health had reduced her to a state of alarming debility. Assisted by my regular aid, Dr. Richardson, her brother, and the apothecary to give the ether, I operated; but owing to the collapse of the brother and the necessity for sending in next door and rousing up another assistant, the operation was protracted, and the quantity of ether used unusually large. This did not have a beneficial effect on the stomach, and it was very evident that we should have to depend on the *rectum*. I enjoined total abstinence from all ingesta by the mouth, and the regular injection of beef-tea and brandy by the rectum.

For eight days this was strictly adhered to, and she improved continuously and rapidly; and when I advised the disuse of the enemata and a return to the ordinary method of feeding, she exclaimed: "Oh! if I could be only fed this way all the time. I feel so much better." For these injections the extract or soluble beef is preferable, since, being more fluid it is more readily absorbed, and its solubility, without sediment, in the smallest quantity of water, renders it possible to give the largest quantity of nutriment in the smallest possible bulk; a

matter of no little moment in the case of children and of an irritable rectum.

To show what extraordinary statements are abroad concerning the action of beef-tea, I extract the following from a popular journal in extensive circulation: "The statement of Liebig that the addition of meat extract to vegetable food increases its nutritive value, and that the extractive matter of meat, especially creatine and creatinine is the material for muscular work, has been disproved by Voit and Meissner, and the idea that beef-tea and meat extract are beneficial on account of the salts they contain is an unlikely one, as these salts are already present in excess in ordinary food. The suggestion, however, that they answer the purpose of stimulants, like coffee, tea, and alcohol, seems to be confirmed by experiment. Small doses of meat extract quickened the pulse, but large ones produced paralysis of the heart and death."

Per contra, I may add that, to Professor Schiff we are indebted for the discovery and demonstration of the fact, that broth and beef-tea contain organic materials which need no digestion to aid their absorption, "but that they contain a nutriment already formed, and afford to the blood organic elements which concur in the formation of the active principles of the secretion of the gastric and pancreatic juices."

In cases of extreme exhaustion from vomiting during pregnancy, Dr. Barker recommends transfusion of blood as a substitute for the induction of labor, or when the latter is considered indispensable as a means of restoring sufficient strength to enable the patient to withstand the shock of the operation. In these cases, I have found that the ordinary Faradaic current, passed from over the solar plexus behind, to the epigastrium in front, in some cases better from the *vertebra prominens*, aided by *general* Faradization, after Beard and Rockwell's plan, will generally produce complete relief when it does not depend on the irritation of a diseased cervical canal; in which case the application of nitrate of silver will have as good an effect. I do not give the very interesting cases contained in my note-

book and in that of my assistant, Dr. Murdock, in support of my assertion, because they are promised, in another paper, to a medical journal. In cases of very sudden and imminent danger, when time for transfusion of blood even can not be had, it might be well to transfuse brandy directly into the veins, or even ammonia slightly diluted, after the method recommended by Professor Halford, of Australia. His method has been misunderstood frequently, and condemned as producing alarming abscesses by those who have injected the fluid into the *cellular tissue* instead of a *vein*. Both Dr. Murdock and I have used *brandy* undiluted in the cellular tissue, half a drachm every half hour, with no unpleasant effect as regards inflammatory action, and with a happy effect on the circulation.

Since this paper was commenced, the most comprehensive work yet published on the transfusion of blood was placed in my hands by Professor Janeway, to whom I return my thanks. It is entitled "Transfusion des Blutes Eine Historische, Kritische und Physiologische Studie, von Franz Gesellius." St. Petersburg and Leipzig. 1873.

Not being familiar with the German language, I am indebted, for assistance in the translation of such parts as I desire to notice, to a young lady friend, who was remarkably successful, though ignorant, of course, of medical terms. I transcribe some of the tables of Gesellius as translated by her :

Table of Transfusion of Animal Blood into Men.

Quantity of blood taken from the person before transfusion.	Quantity injected—ozs.	Kind of animal's blood.	Manner of transfusion.	Operator.	Result.
No depletion	5	Vein blood of ram.	Tube or syringe.	Bliedung, 1839.	Recovery.
?	6	Calf's artery blood.	Direct.	Denis u. Emmerez, 1667.	Died, not from transf'n.
Depletion of few drops	8	Carotids of lamb.	"	City Hospital, Wilmington, N. C., 1871.	Recovery.
Three ounces	9	Carotid of lamb.	"	Denis u. Emmerez, 1667.	Remained perfectly well.
Seven ounces	11	"	"	Lower u. King, 1667.	Recovery.
?	12	"	"	Denis, 1668.	do.
No depletion	14	Defibrinated calf's blood.	Tube.	Esmarch, 1860.	Died.
Thirteen ounces	18	Femoral artery of calf.	Direct.	Denis u. Emmerez, 1667.	Perfectly well.
Ten ounces	20	Femoral artery of lamb.	"	do.	do.
Depletion of greater part of blood	Equally large quantity transfused.	Carotid artery of lamb.	"	Kaufmann and Furmann, 1668.	Recovery.
?	?	"	"	do.	do.
?	?	"	"	do.	do.
?	?	"	"	Riva, 1667.	Remained a long time in a state of melancholy.
No depletion	Few drops.	"	"	do.	Seemed entirely well.
?	?	"	"	do.	Died, not from transf'n.
?	Much blood as desired.	Carotid artery of ram.	"	Paulus Manfredus, 1668.	Recovered.
?	?	Blood serum of a calf.	"	do.	Recovered.
Deplet'n almost to bloodlessness	?		Syringe.	Sokolow, in Moscow, 1847.	Recovered.

History of the case operated on by Denis in 1667. The subject had a severe and tedious fever in which the physicians had bled him twenty times. Before his illness his mind and body were in good condition, memory excellent. Afterwards, his mind seemed stupid, memory nearly gone, and he was so dull and sleepy as to be good for nothing. Denis saw him sitting at the breakfast table fast asleep. After sleeping twelve hours, he could easily be induced to go to bed and pass the whole day in this sort of stupor.

*Quantity and Nature of Blood.*—After depletion of three ounces of thick, black blood, Denis transfused nine ounces of lamb's blood direct from the carotid artery.

*Manner of Transfusion.*—Direct *Überleitung*.

*Circumstances after Operation.*—Boy appeared exceedingly well. After twelve hours, he lost from three to four drops of blood from the nose; all dullness of mind and body disappeared. He grew visibly fatter, and all who knew him were astonished. Complete recovery.

Instance No. 2: Man, forty-five years of age. Operators, Denis and Emmerez, 1667. A robust porter, perfectly healthy; willing, for money's sake, to suffer transfusion. After depletion of ten ounces, twenty ounces of blood from the femoral artery of a lamb were transfused directly.

*After Operation.*—Went gaily to an inn to make merry with his comrades over his money. Remained perfectly well, grew stronger than ever, and offered himself willingly for a second experiment. Satisfactory result.

Instance No. 3: Case of Baron Bond, who had been reduced to extreme debility by a complication of diseases. The transfusion was fatal. The full histories of many other cases from the tables are given.

Quantity bl'd injected at each operat'n		Number of cases.	Quantity bl'd altogether.
Ozs.			Ozs.
1	1849 Norman and Ormond, 1852 Luigi Prejalmani, 1863 Braun (Wien)	3	3
2	1828 Klett and Schraegle, 1830 Kilian, 1831 Kilian, 1838 Berg, 1844 Berg, 1863 Greenhaly, 1863 Thorne, 1865 Thomas	8	16
3	1828 Klett, 1831 Kilian, 1851 Marmonnier Sen., 1869 Buchser, 1870 Antonio Cavaleri and Barbieri.	5	15
3½	1820 Blundell, 1868 Braman	2	7
4	1825 Blundell and Waller, 1826 Ralph, 1826 Jewell 1827 Douglass Fox, 1829 Savy, 1829 Goudin, 1829 Bird, 1829 Philpott, 1830 Ingleby, 1835 Healy and Frazer, 1842 Blasius, 1845 Brown, 1857 Mastin, 1860 Michaux, 1866 Gentlehomme, 1868 Rauten- burg	16	64
5	1827 Barton-Brown, 1834 Kilian, 1835 Turner, 1840 Lane	4	20
6	1851 Devay and Desgranges, 1851 Sacristan	2	12
6½	1866 Martin and Badt, 1870 Beatty	2	13
7	1856 Higginson	1	7
7½	1833 Schneemann	1	7½
8	1826 Doubleday, 1827 Walker 1829 Blundell and Lambert, 1851 Marmonnier Senior	4	32
9	1826 Waller and Doubleday, 1851 Masfen, 1861 Mar- tin.	3	27
10	1860 Higginson, 1870 Martin, 1870 von Belina	3	30
11	1832 Bickersteth	1	11
12	1825 Brigham, 1825 Blundell and Urius, 1833 Walton,	3	36
13	1833 Bauer	1	13
14	1825 Blundell and Doubleday	1	14
15	1828 Howell, Ravis and Doubleday, 1828 Clement, 1863 von Nussbaum	3	45
16	1828 Prichard and Clarke	1	16
17	1857 Wheatkroft	1	17
22	1840 Richard Oliver, 1848 Greaves and Waller	2	44
24	1857 Wheatkroft	1	42*
		68	* Error.

Thus, for every successful transfusion an average of 6, 96 ounces of blood. Besides the above non-fatal cases, there are the following entirely of human blood of which the *quantity* is not mentioned: 1830, Soden's table, No. 13; 1833, Höring; 1842, Wolf in St. Petersburg; 1842, Abele; 1852, Schumann; 1856, Simson; 1859, Higginson; 1858, Dutens. Besides, there

must be counted among the successful, or, to translate literally, not fatal transfusions, those two of Dieffenbach in 1830, resulting in melancholy or erotomania; then the number of not fatal transfusions with human blood will reach the considerable height of seventy-nine cases.

Gesellius gave three other tables similar to the above, which I will not transcribe, but only give the results. The first is a table of fatal cases of transfusion with human blood. Entire (ganzem), fifty two cases. Aggregate amount of blood, 400½ ounces.

The second contains *not fatal* cases of transfusion with defibrinated human blood. Thirty-six cases. 258½ ounces.

The third contains *fatal* cases of transfusion with defibrinated human blood. Sixty-six cases. 460 ounces.

Let us criticise these statistics of Gesellius, for they certainly place the matter of transfusion of blood in a very different light from that in which it must be viewed if we refer to later operations only, those performed in the United States especially. Though this monograph is comprehensive, and as complete as could be expected, with regard to the bibliography of the subject, and the reference to cases, it is lacking in the essentials for the formation of a judgment concerning the *curative* value of transfusion in those desperate cases where all ordinary means are likely to fail, and to which alone it ought to be applied. Without the *details* of the cases, we can not form any opinion as to their fitness for the operation, and consequently as to whether they were *cured* or simply *recovered*. The meagre details which he does give are not calculated to inspire confidence in the accuracy of his tables. For example, case 1: A most remarkable case is dismissed, after the operation, with this brief and unsatisfactory note: "The boy appeared exceedingly well; all dullness of mind and body disappeared. He grew visibly fatter, and all who knew him were astounded." This reads like a miracle. We must infer that he grew visibly fatter at once, that is, that his friends could *see* him grow, and were astounded, as well they might be. Again, case 2: Is that of a *healthy*

man transfused with animal's blood, a most important and interesting experiment; but out of place in statistics designed to show the *curative* value of transfusion. How many more are similar to this we cannot tell. Again, history informs us that, *within a year* after Denis' successful cases (in 1666), so many fatal results followed attempts at transfusion, that it was interdicted by law unless sanctioned by the "Faculty" of Paris; yet the cases mentioned in Gesellius' table as having recovered in 1666 and '67 are all recorded as *recoveries*, except one, which has the significant note: "Died, but not from transfusion." It may be well, also, to mention the fact that a brother German, whose name escapes me, has issued a pamphlet attacking the position of Gesellius, and that the latter has rejoined in a supplementary monograph, and so the contest is going on.

One fact in his tables, however, is of great importance, and will, without doubt, strike most of us with surprise; that is the almost perfect impunity with which it was found possible to inject large quantities of the blood of animals, of different kinds, into the human system. It has, it seems, been tried by quite a number of experimenters, some in this country, and, according to these statistics, with no unfavorable result. It has been considered almost, if not quite, a settled question among us, of late years, that the practice was a dangerous one, and hardly justifiable. In illustration of this, allow me to quote the remarks of Prof. Flint, Jr., in the discussion, in reply to a suggestion of Prof. Peaslee, that experiments should be undertaken to ascertain the degree of safety with which animal's blood could be transfused. He said "that the subject had already been fully investigated by physiologists, and it had been found that the introduction of blood of inferior animals into the circulation of the human subject is attended by very great risk. \* \* \*

The introduction of any considerable quantity would, without doubt, be an exceedingly dangerous experiment to perform. The experiment of introducing the blood of an animal having *oval* corpuscles into the circulation of an animal whose blood contained *round* corpuscles, has already been tried for the pur-

pose of ascertaining, if possible, the length of time occupied by the oval bodies in making the round of the circulation. Experiments of a similar nature have been performed upon sheep, dogs, etc. In all these cases, however, death subsequently followed; which showed that the animal would not tolerate any considerable quantity of blood in the system that had been taken from one of another species" (Op. Cit. p 190). Neither Prof. Dalton nor Prof. Hammond could enlighten me very much on this subject, and both seemed to consider that the question was practically settled until reöpened by the recent publication of those experiments recorded in the monograph of Gesellius. However, Dr. Hammond himself, in August, 1849, performed two of these experiments with the blood of animals, but never made them public, because, being then a young assistant surgeon in the army, he feared to bring down on himself the ire of his superiors for rash experiments. He was in camp, *en route* for New Mexico, when the cholera broke out in his command. A Swiss, 22 years old, was in collapse, and moribund. With a most imperfect apparatus, he transfused from 16 to 18 ounces of bullock's blood. In the case of a German, 40 years old, in the same desperate strait, he did the same. They both revived, and lived about six hours. He considered that their life was, without doubt, prolonged.

Dr. Flint speaks of transfusing blood containing *oval* corpuscles, and says animals will not tolerate blood in the system belonging to another species. He means probably blood containing corpuscles of a different size and shape. But why resort to blood of this description, when the blood of all the mammalia contains *round* corpuscles, and, what is remarkable and important, *smaller* corpuscles than the human subject. Thus, according to Gulliver and other physiologists, the corpuscles of man measure 1-3200 of an inch; those of the ox 1-4267; of the sheep 1-5300; and even that of the rhinoceros is less than that of man. As Prof. Dalton remarked to me, "His (Gesellius') experiments may be well worth following out." In the "Medical Record" for May 15, I find a short paragraph from

a German newspaper stating that Dr. Hasse, of Nordhausen, has transfused successfully with lamb's blood in twenty-three cases. He does not state if he had any unsuccessful cases. These cases date only from May, 1873. He transfused *directly* from the artery of the animal to the vein of the patient. That one individual, in less than twelve months, should have had twenty-three cases actually *requiring* transfusion, seemed incredible. But, subsequently, on consulting the periodical, from which the extract was taken,\* I find some explanation in the fact there stated that, in at least twelve of these cases, and twelve only are referred to at all, they were not such as to involve the issue of life and death, but mainly of expediency. "Five were cases of phtthisis, two chlorosis, two cachexia after severe illness, one cachexia after caries of vertebræ, one *carcinoma ventriculi*, and one severe hæmorrhage after *placenta prævia*. This last case recovered rapidly. The two cases of general cachexia recovered gradually, and the chlorotic case only very slowly. The patient with carcinoma was temporarily benefitted, and the one with spinal disease improved in general health and had less suppuration. The results in the phtthisical patients were wonderfully satisfactory." They would have been more satisfactory if we knew what the results were, whether they were temporary or permanent, etc. There is just this indefiniteness about almost all these reports of transfusion which prevents their being of much practical value to us as statistics. Now we see in what a different light these statistics appear, with this additional history, from that reflected on them by the short paragraph in the "Record." Now, as regards the *immediate* effect of the transfusion of animal's blood, we get some information to which Gesellius' extensive monograph does not allude. It is stated that "the reaction following the operation was very violent. There was marked dyspnœa, which even amounted nearly to apnœa, and necessitated interruption of the operation after sixty or ninety seconds. Half an hour after, there

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\* (Tagesblatt du 46 Norsammlung Deutcher Naturfoscher; Wiesbaden; No. 7, 1873). London Medical Times and Gazette, May 30, 1874, p 597.

was a violent rigor, and the temperature rose to 40.9 C. (105.6) F., and deep sleep followed, and on waking a feeling of comfort was experienced. The patients quickly gained several pounds in weight (how quickly?), and their muscular strength and mental energy rapidly improved. In a few cases there was a slight excretion of albumen, and the coloring matter of the blood in the urine." In this connection it is important to quote the interesting experiments very lately made by Dr. Landois, of Griefswald, "to determine the changes which take place in the blood of one animal when transfused into another of a different species." He was led to investigate the subject in consequence of the use which has lately been made of animal's blood for transfusion into the human subject; and his results are published in the "Centralblatt" for Dec. 1873, Nos. 56 and 57.\*

"Dogs were injected with the blood of man, of sheep, cat, guinea-pig, calf, pig and pigeon, etc. The frog was especially studied as the subject of transfusion of the blood of all the animals enumerated, as well as of the pike, and the *rana esculenta* was injected with the blood of the *rana temporaria*. It was found that if from 0.5 to 0.8 cubic centimetres of fresh or defibrinated mammalia blood were injected into the veins of a large frog, changes rapidly occurred in it, the most marked being a dissolution of the red corpuscles, so that the frog's serum acquired a deep ruby-red lac color, (Lackfarbe) from the hæmoglobin set free from the corpuscles. In transfusions with rabbit's blood, the dissolution was nearly completed in from three to five minutes, and in other animals generally in from twenty to thirty minutes. Dog's and pigeon's blood resisted the longest."

Among a variety of other interesting and ingenious experiments, which require more space than I have at command, a "frog's blood (either fresh or defibrinated) was also mixed with the blood of other animals, and examined microscopically, or else their blood was examined in frog's serum. It was then found that the red corpuscles, often after assuming an irregular

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\* London Medical Times and Gazette, May 30, 1874.

outline, and exhibiting lively molecular movements, became perfectly globular, and so appear smaller than before; they then become paler and paler, till at last only the "stroma"\* remains visible, and this at last also disappears. The stromata often aggregate into masses, and thus can give rise to embolisms, and consecutive inflammatory phenomena in the circulation." The blood of one mammal dissolved the corpuscles of another, but in very varying degrees, according to the animal. The corpuscles of one being much more resisting than those of another, while the serum of one has also much more solvent power than that of another. It would seem as if we should be influenced by this fact, if it is established by other observers, in our choice of animals for transfusion. "The dissolved constituents of the blood are disposed of in two ways; they are partly excreted principally by the urine, but in smaller and uncertain quantities by the bowels, uterus, bronchi, and into the serous cavities. The other part probably goes to the nutrition of the receiver."

Dr. Landois "believes that transfusion may benefit the receiver in three ways—1. By bringing nutritive material into his body. 2. By the oxygen which is derived from the dissolved blood-cells, and in its serum. 3. By possibly, in certain circumstances, improving the mechanical conditions of the circulation. He does not think that there is much probability of the foreign blood-cells ever taking on themselves the physiological functions of those of their receiver."

"In consequence of the partial destruction of the cells of the receiver's blood by the foreign serum in some animals (e. g. the rabbit), symptoms of great severity and danger may occur after the operation, such as immensely quickened respiration, dyspncea, convulsions, and even death, or asphyxia may follow it." Symptoms of this kind actually, as we have seen, did follow it in Dr. Hasse's cases. "If life is sufficiently prolonged, the urine becomes bloody and albuminous." "Death may occur, after copious transfusions from the rapid massing together of

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\* The term "stroma" applied by Rollet to the blanched, pale, globular residue of the red corpuscle after removal of the coloring matter.

the foreign (or the animal's own) blood-cells, which leads to extensive coagulations of fibrin in the vessels; and many kinds of blood exhibit the phenomenon that, when mixed with other blood, their corpuscles aggregate into masses, which may give rise to capillary embolisms in the lungs. The danger of the transfusion, then, into the blood of different animals, depends on the relation of the species employed."

Since commencing this paper, some additional cases have occurred, or have fallen under my notice, to which it is necessary to refer; but first I desire to review briefly a case mentioned by Dr. Barker, that occurring at Bellevue Hospital, and concerning which some additional particulars have come to my knowledge within a few days. The subject of this case, reported by Dr. F. J. Metcalfe, I happened to see and examine the day previous to the operation. There was a sudden loss of a very large quantity of blood some hours after the operation. The patient was not pulseless at any time. My friend, Dr. B. D. Taylor, now of Highland Falls, near West Point, who performed the operation, informs me that he furnished sixteen ounces of blood from his own arm, and another member of the house-staff furnished three ounces, the largest amount of human blood which I have known to have been used in any case. This was aided by nutritious and stimulating enemata, digitalis to stimulate the heart's action, hypodermic injections of strychnia, and the patient survived, according to Dr. Taylor's recollection, twenty-four hours; according to Dr. Metcalfe's report, "forty-eight, to sixty hours," and yet she succumbed at last. This is, therefore, a very discouraging case, and should stimulate a further inquiry into one mooted point; whether it is not proper, in all cases, to keep the vessels *filled*; if not with blood, with a proper saline solution, added to it, or injected in the intervals of the sanguineous injections, *pro re nata*, or with the blood of animals. Two cases, which will now be mentioned, seem to render it still more difficult to generalize, or to draw definite conclusions as to the proper method of transfusion, especially as to the *amount* of blood necessary, or even safe.

It has been stated, in the discussion before the Academy of Medicine, that six cases have occurred in this city, all fatal. In 1869, one of the most interesting cases on record occurred, and a successful one. Dr. Buchser, of this city, was the operator, assisted by Dr. Guleke. It is reported in the "Medical Record" for October, 1869, and referred to by Gesellius as having occurred in 1868. In this case it certainly appears that no remedy short of transfusion of blood would have availed; and, strange to say, only three ounces of blood (not defibrinated) were used. The following significant fact is noted: "July 1. Patient received ferri carbonat. alcohol, and drank daily two quart-bottles of claret. Previous to his illness was never used to wine, and now states that he could drink a quart at once without any ill effects." In the very number of the Record (April 1, 1874), containing the report of Dr. Barker's paper is a report by Dr. Joseph W. Howe, surgeon to the Charity Hospital, of a very successful case; with the recommendation also of perhaps the simplest and best method of performing the operation. Here, also, only a small quantity of blood was injected (four ounces). In only two of the cases alluded to by Dr. Barker, in his paper, is the quantity of blood mentioned, a very unfortunate circumstance, but for which he is not, of course, responsible. But, in both of them, the amount is comparatively large; eight ounces and thirteen, or, according to Dr. Taylor, nineteen ounces. During the discussion, Dr. Peaslee remarked that he "had been struck with the fact that the use of so small a quantity of blood had caused the recovery of the patient in many reported cases"; that is, from two to four ounces. "He had been inclined," he says, "to reject these individual cases as not being very reliable."

Within the past few days, my medical friends have furnished me two other cases never published. The first occurred some eighteen months ago at Bellevue Hospital, for the account of which I am indebted to J. C. Young, M. D., of the resident medical staff. The second occurred a few days ago at the New York State Woman's Hospital, for the history of which I

am indebted to the operator, Professor T. Gaillard Thomas.

CASE I.—John Dauphy, aged twenty-two, was run over by a railroad car and sustained a compound comminuted fracture of left humerus, complicated by an opening into the shoulder-joint. Sent to Centre-street Reception Hospital, where the brachial and other arteries were found bleeding, and tied, but not until a large amount of blood had been lost. Received into Bellevue Hospital the following day at 1:15 P. M. Dr. Wood immediately performed amputation at shoulder-joint. Five hours after, the pulse rose to 160, and became very weak and gaseous. He continued to lose some blood after both operations. Stimulants and food were given him by every channel. At 2 o'clock A. M. the patient sank so low that transfusion was decided upon. Five ounces of blood were taken from the arm of Dr. Terriberry; it was surrounded by warm water and defibrinated, and, by means of a syringe enveloped in warm cloths, was injected into the median basilic vein of the patient. Force of the heart and pulse a little increased, and the frequency diminished ten beats. One hour later six additional ounces were injected with about the same result. But shortly after this the patient became delirious, and continued in this state until 6 A. M., when he died.

CASE II.—In reply to your letter of the 11th, I state that I transfused blood into the vein of a patient from whom I had removed, by gastrotomy, a fibrous tumor of the uterus weighing fifty pounds. The transfusion was performed about seventeen hours after the operation, and at the time the patient was pulseless at the wrist. About four ounces of defibrinated blood were introduced into the patient's arm. In a short time a flickering pulse was perceptible in the radial artery, and the patient, who was, at the time, apparently *in articulo mortis*, rallied and survived about twenty-four hours. I repeated the operation in about eighteen hours after this time (forty-two hours after removal of tumor), and injected about six ounces more of defibrinated blood. But this seemed to have no marked effect, and the patient died. The blood was obtained from strong and

healthy men. I commenced the operation with Aveling's apparatus, which I found impracticable, and resorted to an instrument made by Tiemann, on the principle of the stomach-pump. I think life was prolonged for twenty-four hours by the operation.

These two histories of operations performed in two of our great hospitals, by men well accustomed to surgical manipulations, only emphasize more strongly the remarks already made. It is well to note the failure of Aveling's instrument, in Prof. Thomas' hands, so highly commended lately.

Just at the last moment, I have received a letter from Dr. Joseph W. Howe, furnishing the notes of another case of transfusion performed by him at Charity Hospital a few days ago. They are as follows :

"The patient was very much reduced by excessive discharge from a large ulcer of the leg and necrosed bone. I first placed in the aspirator (this is the instrument recommended by Dr. Howe for transfusion) a solution containing ten grains of carbonate of ammonia, which became mixed with the blood as it entered the instrument (this is to prevent coagulation); I injected about six ounces altogether. The patient's appetite and strength improved for about a week, and then began to fail. He left the hospital in about the same condition as when the transfusion was made."

I am aware that the foregoing observations have somewhat of a desultory and disconnected character, due partly to the fact that an important portion of the information which they involve fell under my notice after the greater part of my paper had been prepared. It was not intended, by any means, to be exhaustive of the subject, or to present any novel facts or theories; nor does it even seek to *establish* any point of practice, but simply to bring this question before the Profession in all its bearings, which has never yet been done. As has been stated, there have been periods in medical history when a sort of fashion for experiments in transfusion has arisen; and, for a few years, quite enthusiastic efforts have been made by distinguished men

in different countries to establish the practice; but a reaction has, each time, led to its almost total abandonment for a long period. One of these revivals occurred in 1819 through the experiments of Dr. Blundell, of London. Quite recently symptoms of another revival have manifested themselves, and now appears to be an auspicious period for such a thorough scientific investigation of the whole subject, as the exacting spirit of the age demands, as has been accorded to other mooted questions of professional importance, and such as may effect the establishment of some *principles* by which we may be guided in forming an opinion as to the propriety of the operation, and as to the details of its execution.

At present we are, to employ an expressive, if not scientific phrase, all at sea on this subject; as to what conditions of accident or disease it is applicable; whether blood or some other fluid should be employed, alone or mixed, or interchangeably; if blood is necessary, whether animal or human; whether animal's blood is even safe in a healthy subject, whether it should be defibrinated; how much is necessary or safe; how often a repetition is called for; what apparatus shall be preferred; what auxiliary means are proper or essential. Can any one answer any of these questions satisfactorily to any person but himself? Or can we consider any one of these important points established?

N. B.—Since this paper was read, I find in the July number of this Journal an article on transfusion by Dr. Morton, of the Pennsylvania Hospital, in which he gives the histories of three successful cases of his own and four of Dr. J. G. Allen, two of which may be called successful. Defibrinated blood was used. In some of the cases the *amount* is not given. The smallest amount was two ounces (successful), the largest eleven ounces.

In the same number is a short paragraph extracted from the "British Medical Journal," giving the experience of several distinguished German experimenters with animal's blood, besides those mentioned in this paper. Küster mentions serious symptoms supervening upon the injections, as dyspnœa, cyano-

sis, pains, shivering, rise of temperature, etc. These symptoms, as usual, disappeared after the lapse of a few hours. Sander, of Barmen, also warns against the indiscriminate use of animal's blood. One of his patients had symptoms of uræmia, which lasted four days. It is very evident that further experiments with animal's blood should be made; and that, if possible, some measures should be devised for obviating these unpleasant symptoms. It might be well to try the effect of diluting the blood with proper saline solutions, such as have been often resorted to successfully, and to which allusion has been made in this paper.

I deem it my duty to state that, within a day or two, I have seen Dr. Ely, who informs me that his patient gradually sank and died, after his letter was written, with symptoms of rapid phthisis pulmonalis, constant cough, and abundant purulent expectoration. She had never enjoyed good health, and such a development, under the circumstances, is not at all surprising.





