CHAPTER VIII.

THE TRANSFUSION OF BLOOD.

The Transfusion of Blood in desperate and apparently hopeless cases of hemorrhage offers a possible means of rescuing the patient which merits careful consideration. It has again and again attracted the attention of the profession, but has never become popularized in obstetric practice. The reason of this is not so much the inherent defects of the operation itself—for quite a sufficient number of successful cases are recorded to make it certain that it is occasionally a most valuable remedy—but the fact that the operation has been considered a delicate and difficult one, and that it has been deemed necessary to employ a complicated and expensive apparatus, which is never at hand when a sudden emergency arises. Whatever may be the difference of opinion about the value of transfusion, I think it must be admitted that it is of the utmost consequence to simplify the process in every possible way; and it is above all things necessary to show that the steps of the operation are such as can be readily performed by any ordinarily qualified practitioner, and that the apparatus is so simple and portable as to make it easy for any obstetrician to have it at hand. There are comparatively few who would consider it worth while to carry about with them, in ordinary every-day work, cumbrous and expensive instruments which may never be required in a life-long practice; and hence it is not unlikely that, in many cases in which transfusion might have proved useful, the opportunity of using it has been allowed to slip. Of late years the operation has attracted much attention, the method of performing it has been greatly simplified, and I think it will be easy to prove that all the essential apparatus may be purchased for a few shillings, and in so portable a form as to take up little or no room; so that it may be always carried in the obstetric bag ready for any possible emergency.

History of the Operation.—The history of the operation is of considerable interest. In Villari's *Life of Savonarola*, it is said to have been employed in the case of Pope Innocent VIII., in the year 1492, but I am not aware on what authority the statement is made. The first serious proposals for its performance do not seem to have been made until the latter half of the seventeenth century. It was first actually performed in France by Denis, of Montpellier, although Lower, of Oxford, had previously made experiments on animals which satisfied him that it might be undertaken with success. In November, 1667, some months after Denis's case, he made a public experiment at Arundel House, in which twelve ounces of sheep's blood were injected into the veins of a healthy man, who is stated to have been very well after the operation, which must, therefore, have proved successful. These nearly simultaneous cases gave rise to a controversy as to priority of invention, which was long carried on with much bitterness.

The idea of resorting to transfusion after severe hemorrhage does not seem to have been then entertained. It was recommended as a means of treatment in various diseased states, or with the extravagant hope of imparting new life and vigor to the old and decrepit. The blood of the lower animals only was used; and, under these circumstances, it is not surprising that the operation, although practised on several occasions, was never established as it might have been had its indications been better understood.

From that time it fell almost entirely into oblivion, although experiment and suggestions as to its applicability were occasionally made, especially by Dr. Harwood, Professor of Anatomy at Cambridge, who published a thesis on the subject in the year 1785. He, however, never carried his suggestions into practice, and, like his predecessors, only proposed to employ blood taken from the lower animals. In the year 1824 Dr. Blundell published his well-known work entitled *Researches, Physiological and Pathological*, which detailed a large number of experiments; and to that distinguished physician belongs the undoubted merit of having brought the subject prominently before the profession, and of pointing out the cases in which the operation might be performed with hopes of success. Since the publication of this work, transfusion has been regarded as a legitimate operation under special circumstances; but, although it has frequently been performed with success, and in spite of many interesting monographs on the subject, it has never become so established as a general resource in suitable cases as its advantages would seem to warrant. Within the last few years more attention has been paid to the subject, and the writings of Panum, Martin, and De Belina on the Continent, and of Higginson, McDonnell, Hicks, Aveling, and Schäfer in Great Britain, amongst others, have thrown much light on many points connected with the operation.

Nature and Object of the Operation.—Transfusion is practically only employed in cases of profuse hemorrhage connected with labor, although it has been suggested as possibly of value in certain other puerperal conditions, such as eclampsia or puerperal fever. Theoretically it may be expected to be useful in such diseases; but, inasmuch as little or nothing is known of its practical effects in these diseased states, it is only possible here to discuss its use in cases of excessive hemorrhage. Its action is probably twofold: first, the actual restitution of blood which has been lost; second, the supply of a sufficient quantity of blood to stimulate the heart to contraction, and thus to enable the circulation to be carried on until fresh blood is formed. The influence of transfusion as a means of restoring lost blood must be trivial, since the quantity required to produce an effect is generally very small indeed, and never sufficient to counterbalance that which has been lost. Its stimulant action is no doubt of far more importance; and if the operation be performed before the vital energies are entirely exhausted, the effect is often most marked.

Use of Blood taken from the Lower Animals.—In the earliest operations the blood used was always that of the lower animals, generally of the sheep. It has been thought by Brown-Séquard and others that the blood of some of the lower animals, especially of those in which the corpuscles are of smaller size than in man, as of the sheep, might be used with safety, provided it is not too rich in carbonic acid and too poor in oxygen, and injected in small quantity only. Landois,[1] however, has conclusively proved that the blood of any of the lower animals has a most injurious effect on the human red corpuscles, which rapidly become swollen and decolorized, and discharge their coloring matter into the serum. It is certain, therefore, that this plan cannot be adopted in practice.

The great practical difficulty in transfusion has always been the coagulation of the blood very shortly after it has been removed from the body. When fresh-drawn blood is exposed to the atmosphere, the fibrin commences to solidify rapidly, generally in from three to four minutes, sometimes much sooner. It is obvious that the moment fibrination has commenced, the blood is, *ipso facto*, unfitted for transfusion, not only because it can be no longer passed readily through the injecting apparatus, but because of the great danger of propelling small masses of fibrin into the circulation, and thus causing embolism. Hence, if no attempt be made to prevent this difficulty, it is essential, no matter what apparatus is used, to hurry on the operation so as to inject before fibrination has begun. This is a fatal objection, for there is no operation in the whole range of surgery in which calmness and deliberation are so essential, the more so as the surroundings of the patient in these unfortunate cases are such as to tax the presence of mind and coolness of the practitioner and his assistants to the utmost.

All the recent improvements have had for their object the avoidance of coagulation, and practically this has been effected in one of three ways: First, by immediate transfusion from arm to arm, without allowing the blood to be exposed to the atmosphere, according to the methods proposed by Aveling, Roussel, and Schäfer. Second, by adding to the blood certain chemical reagents which have the property of preventing coagulation. Third, removal of the fibrin entirely by promoting its coagulation and straining the blood, so that the liquor sanguinis and blood corpuscles alone are injected.

Inasmuch as the success of the operation altogether depends on the method adopted, it will be well, before going further, to consider briefly the advantages and disadvantages of each of these plans.

Aveling's Method.—The method of immediate transfusion has been brought prominently before the profession by Dr. Aveling, who has invented an ingenious apparatus for performing it. The apparatus consists essentially of a miniature Higginson's syringe, without valves, and with a small silver canula at either end. One canula is inserted into the vein of the person supplying blood, the other into a vein of the patient, and by a curious manipulation of the syringe, subsequently

[1] Die Transfusion des Blutes, Leipzig, 1875.

to be described, the blood is carried from one vein into the other. It must be admitted that if there were no practical difficulties, this instrument would be admirable, and it is, therefore, not surprising that it should have met with so much favor from the profession. I cannot but think, however, that the operation is not so simple as at first sight appears, and that therefore it wants one of the essential elements required in any procedure for performing transfusion. One of my objections is, that it is by no means easy to work the apparatus without considerable practice. Of this I have satisfied myself by asking members of my class to work it after reading the printed directions, and finding that they are not always able to do so at once. Of course, it may be said that it is easy to acquire the necessary manipulative skill; but when the necessity for transfusion arises, there is not time left for practising with the instrument, and it is essential that an apparatus, to be universally applicable, should be capable of being used immediately and without previous experience. Other objections are—the necessity of several assistants, the uncertainty of there being a sufficient circulation of blood in the veins of the donor to afford a constant supply, and the possibility of the whole apparatus being disturbed by restlessness or jactitation on the part of the patient. For these reasons it seems to me that this plan of immediate transfusion is not so simple, nor so generally applicable, as defibrination. Still, it is impossible not to recognize its merits, and it is certainly well worthy of further study and investigation.

Roussel's Method.—Another method of immediate transfusion is that recommended by Roussel,[1] whose apparatus has recently attracted considerable attention. It possesses many undoubted advantages, and is beyond doubt a valuable addition to our means of performing the operation. It has, however, the great disadvantage of being costly and complicated, and hence I do not believe that it is likely to come into general use.

Schäfer's Method.—The third method is that recommended by Dr. Schäfer in his recent excellent reports on transfusion submitted to the Obstetrical Society.[2] Schäfer suggests two methods of performing the operation: one from vein to vein, the other from artery to artery. The latter, he holds, has the advantage of supplying pure oxygenated blood, under the best possible conditions for securing the amelioration of a patient suffering from the effects of profuse hemorrhage. The necessary operative proceedings are, however, somewhat complicated, and it seems to me very doubtful if this plan is likely to be at all commonly used. His method of immediate transfusion, however, is very simple, and is well worthy of trial. In his experiments on the lower animals it answered admirably. I am not aware that it has yet been tried on the human subject, but I do not see any practical difficulty in its application. For the description of the operation I have inserted Dr. Schäfer's own directions for the performance of venous immediate transfusion.

The second plan for obviating the bad effects of clotting is the addi-

[1] Obstetrical Transactions for 1876, vol. xviii. p. 280.
[2] Ibid., vol. xxi. p. 316.

tion of some substance to the blood which shall prevent coagulation. It is well known that several salts have this property, and the experiments made in the case of cholera patients prove that solutions of some of them may be injected into the venous system without injury. This method has been specially advocated by Dr. Braxton Hicks, who uses a solution of three ounces of fresh phosphate of soda in a pint of water, about six ounces of which are added to the quantity of blood to be injected. He has narrated four cases[1] in which this plan was adopted successfully, so far as the prevention of coagulation was concerned. It certainly enables the operation to be performed with deliberation and care, but it is somewhat complicated, and it may often happen that the necessary chemicals are not at hand. A further objection is the bulk of fluid which must be injected, and there is reason to believe that this has in some cases seriously embarrassed the heart's action and interfered with the success of the operation. In many of the successful cases of transfusion the amount of blood injected has been very small, not more than two ounces. Dr. Richardson proposes to prevent coagulation by the addition of liquor ammoniæ to the blood, in the proportion of two minims diluted with twenty minims of water to each ounce of blood.

Defibrination of the Blood.—The last method, and the one which, on the whole, I believe to be the simplest and most effectual, is defibrination. It has been chiefly practised in the British Isles by Dr. McDonnell, of Dublin, who has published several very interesting cases in which he employed it, and on the Continent by Martin, of Berlin, and De Belina, of Paris. The process of removing the fibrin is simple in the extreme, and occupies a few minutes only. Another advantage is that the blood to be transfused may be prepared quietly in an adjoining apartment, so that the operation may be performed with the greatest calmness and deliberation, and the donor is spared the excitement and distress which the sight of the apparently moribund patient is apt to cause, and which, as Dr. Hicks has truly pointed out, may interfere with the free flow of blood. The researches of Panum, Brown-Séquard, and others have proved that the blood corpuscles are the true vivifying element, and that defibrinated blood acts as well in every respect as that containing fibrin. It has been proved that the fibrin is reproduced within a short time,[2] and the whole tendency of modern research is to regard it, not as an essential element of the blood, but as an excrementitious product, resulting from the degradation of tissue, which may, therefore, be advantageously removed. Another advantage derived from defibrination is, that the corpuscles are freely exposed to the atmosphere, oxygen is taken up, and carbonic acid given off, and the dangers which Brown-Séquard has shown to arise from the use of blood containing too much carbonic acid are thereby avoided. There can be, therefore, no physiological objection to the removal of the fibrin, which, moreover, takes away all practical difficulty from the operation. The straining to which the defibrinated blood is subjected entirely prevents the possibility of even the most minute particle of fibrin being contained in the

[1] Guy's Hospital Reports, 1869, vol. xiv., 3d series, p. 1.
[2] Panum: Virchow's Arch., vol. xxvii.

injected fluid; the risk from embolism is, therefore, less than in any of the other processes already referred to. My own experience of this plan is limited to three cases, but in two it answered so well that I can conceive no reasonable objection to it. I should be inclined to say that transfusion, thus performed, is amongst the simplest of surgical operations—an opinion which the experience of McDonnell and others fully confirms.

Transfusion of Milk.—Recently the intra-venous injection of freshly-drawn warm milk has been recommended as a substitute for blood, chiefly in America. It was first used by Dr. Hodder, of Toronto, but has been introduced and strongly advocated by Thomas, of New York, who has used it twice after ovariotomy. Brown-Séquard, in experimenting on the lower animals, found that it answered as well as either fresh or defibrinated blood, and about half an hour after the injection no trace of the milk corpuscles could be found in the blood. Schäfer, however, found that the action of milk on the blood corpuscles was highly deleterious, and that it introduces the germs of septic organisms likely to produce very serious results. He, therefore, pronounces strongly against its use.

Injection of Saline Solutions.—Dr. William Hunter[1] has recently published a series of valuable observations on the subject of transfusion. His conclusions are that its principal effects are those of stimulation, and that, for all practical purposes, in cases of severe hemorrhage, the injection of a saline solution is quite as efficacious, and much simpler. For this purpose all that is required is a glass canula, such as Schäfer's, a piece of India-rubber tubing, and a syringe, all of which should be, of course, carefully aspecticized. The fluid to be injected is very readily manufactured by dissolving a teaspoonful of common salt in a pint of water at a temperature of 100°. It has been suggested[2] that the injection of the same solution into the muscular tissues will answer equally well. For this purpose the needle of an aspirator is attached by a piece of India-rubber tubing to an ordinary glass funnel. The needle is inserted into the gluteal region or loins, and the saline infusion poured into the funnel. After it has entered the tissues it is diffused by massage. Both these methods have the great advantage of simplicity, and, if further experience proves them to be as efficacious as they are said to be, will prove valuable in many cases in which the transfusion of blood cannot be employed.

Statistical Results.—The number of cases of transfusion are perhaps not sufficient to admit of completely reliable conclusions. It is certain, however, that transfusion has often been the means of rescuing the patient when apparently at the point of death, and after all other means of treatment had failed. Professor Martin records 57 cases, in 43 of which transfusion was completely successful, and in 7 temporarily so; while in the remaining 7 no reaction took place. Dr. Higginson, of Liverpool, has had 15 cases, 10 of which were successful. Figures such as these are encouraging, and they are sufficient to prove that the operation is one which at least offers a fair hope of

[1] Brit. Med. Journ., vol. ii., 1869.
[2] Münchmeyer: Arch. für Gynäk., Bd. xxxiv, Hft. 3.

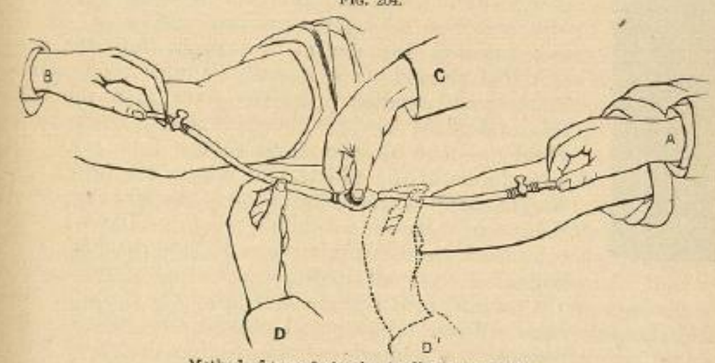
success, and which no obstetrician would be justified in neglecting, when the patient is sinking from the exhaustion of profuse hemorrhage. It is to be hoped also that further experience may prove it to be of value in other cases in which its use has been suggested, but not, as yet, put to the test of experiment.

Possible Dangers of the Operation.—The possible risks of the operation would seem to be the danger of injecting minute particles of fibrin which form emboli; of bubbles of air; or of overwhelming the action of the heart by injecting too rapidly, or in too great quantity. These may be, to a great extent, prevented by careful attention to the proper performance of the operation, and it does not clearly appear, from the recorded cases, that they have ever proved fatal. We must also bear in mind that transfusion is seldom or never likely to be attempted until the patient is in a state which would otherwise almost certainly preclude the hope of recovery, and in which, therefore, much more hazardous proceedings would be fully justified.

Cases Suitable for Transfusion.—The cases suitable for transfusion are those in which the patient is reduced to an extreme state of exhaustion from hemorrhage during or after labor or miscarriage, whether by the repeated losses of placenta prævia, or the more sudden and profuse flooding of post-partum hemorrhage. The operation will not be contemplated until other and simpler means have been tried and failed, or until the symptoms indicate that life is on the verge of extinction. If the patient should be deadly pale and cold, with no pulse at the wrist, or one that is scarcely perceptible; if she be unable to swallow, or vomits incessantly; if she lie in an unconscious state; if jactitation, or convulsions, or repeated faintings should occur; if the respiration be laborious, or very rapid and sighing; if the pupils do not act under the influence of light, it is evident that she is in a condition of extreme danger, and it is under such circumstances that transfusion, performed sufficiently soon, offers a fair prospect of success. It does not necessarily follow because one or other of these symptoms is present that there is no chance of recovery under ordinary treatment, and, indeed, it is within the experience of all that patients have rallied under apparently the most hopeless conditions. But when several of them occur together, the prospect of recovery is much diminished, and transfusion would then be fully justified, especially as there is no reason to think that a fatal result has ever been directly traced to its employment. Indeed, like most other obstetric operations, it is more likely to be postponed until too late to be of good service, than to be employed too early; and in some of the cases reported as unsuccessful it was not performed until respiration had ceased and death had actually taken place. It has sometimes been said that transfusion should never be employed if the uterus be not firmly contracted, so as to prevent the injected blood again escaping through the uterine sinuses. The cases in which this is likely to occur are few; and if one were met with, the escape of blood could be prevented by the injection into the uterus of the perchloride of iron.

Description of the Operation.—In describing the operation I shall limit myself to an account of Aveling's and Schäfer's method of immediate transfusion, and to that of injecting defibrinated blood. I consider myself justified in omitting any account of the numerous instruments which have been invented for the purpose of injecting pure blood, since I believe the practical difficulties are too great ever to render this form of operation serviceable. The great objection to most of them is their cost and complexity; and as long as any special apparatus is considered essential, the full benefits to be derived from transfusion are not likely to be realized. The necessity for employing it arises suddenly; it may be in a locality in which it is impossible to procure a special instrument; and it would be well if it were understood that transfusion may be safely and effectually performed by the simplest means. In many of the successful cases an ordinary syringe was used; in one, in the absence of other instruments, a child's toy syringe was employed. I have myself performed it with a simple syringe purchased at the nearest chemist's shop, when a special transfusion apparatus failed to act satisfactorily.

FIG. 204.



Method of transfusion by Aveling's apparatus.

In immediate transfusion (Fig. 204), the donor is seated close to the patient, and the veins in the arms of each having been opened, the silver canula at either end of the instrument is introduced into them (A B). The tube between the bulb and the donor is now pinched (D), so as to form a vacuum, and the bulb becomes filled with blood from the donor. The finger is now removed so as to compress the distal tube (D′), and the bulb being compressed (C), its contents are injected into the patient's vein. The bulb is calculated to hold about two drachms, so that the amount injected can be estimated by the number of times it is emptied. The risk of injecting air is prevented by filling the syringe with water which is injected before the blood.

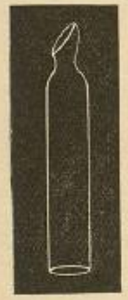
SCHÄFER'S DIRECTIONS FOR IMMEDIATE TRANSFUSION.

Direct Venous Transfusion.—"Procure two glass canulas of appropriate size and shape (see Fig. 205), and a piece of black India-rubber

tubing, seven inches long, and not less than a quarter of an inch bore, fitted to the canulas. This apparatus could always be improvised.

"Place the transfusion-tube in a basin of hot water containing a little carbonate of soda. Put a tape around the arm of the patient just below the place where the vein is to be opened, and another just above. Expose the vein by an incision through the skin, which should be made transversely if the position of the vein cannot be made out through the skin. Clear a small piece of the vein with forceps, and slip a pointed piece of card underneath it. By a snip with scissors make an oblique opening into the vein, and partly insert a small blunt instrument (such as a wool-needle) so that the aperture is not lost. Remove the upper tape. Next prepare the vein of the giver. To do this put tapes around the arm just below and above the place where the vein is to be opened. Expose the vein by a longitudinal incision through the skin. Clear a small piece of the vessel with forceps and pass a thread ligature underneath. A slip of card may also be placed under this vein. Make a snip into the vein just above the ligature, and then, taking the transfusion-tube out of the soda solution, slip one of the canulas into the vein of the giver, and tie it in with a simple knot, which can be readily untied. Let the giver go to the bedside and place his arm alongside that of the patient. Hold the end of the India-rubber tube with the second canula up a little, and release the lower tape on the arm of the blood-giver. As soon as blood flows out of the second canula pinch the India-rubber tube close to the canula, so as to stop the flow, and, removing the wool-needle, slip the end of the canula into the vein of the patient, hold it there, and allow the blood to pass freely along the tube. Three minutes will generally be long enough for the flow, which can be stopped by compressing the vein of the giver below the canula. Both canulas may now be withdrawn and the ligature removed from the vein of the giver, the cut veins being dealt with in the usual way. Of course, the other tape on the arm of the donor must be removed as soon as the transfusion is over.

Fig. 205.



"Instead of using the transfusion-tube empty, it may be filled with soda solution, to the exclusion of air. It is necessary to have one or two spring clips on the tube to prevent the escape of the solution. This is a much better plan than the other, for the blood need not be allowed to flow into the tube until the second canula is inserted, and then, by opening the clips, it may drive the soda solution before it into the vein. The small quantity of carbonate of soda solution necessary to fill the simple tube will do the patient no harm."

Injection of Defibrinated Blood.—For injecting defibrinated blood various contrivances have been used. McDonnell's instrument is a simple cylinder with a nozzle attached, from which the blood is propelled by gravitation. When the propulsive power is insufficient, increased pressure is applied by breathing forcibly into the open end of the receiver. De Belina's instrument is on the same principle, only atmospheric pressure is supplied by a contrivance similar to Richardson's spray-producer, attached to one end. The idea is simple, but there is some doubt of a gravitation instrument being sufficiently powerful, and it certainly failed in my hands. I have had the valves applied to Aveling's instrument, so that it works by compression of the bulb, like an ordinary Higginson's syringe. This, with a single silver canula at one end for introduction into the vein, forms a perfect and inexpensive transfusion apparatus, taking up little space. If it be not at hand, any small syringe with a fine nozzle may be used.

The first step of the operation is defibrination of the blood, which should, if possible, be prepared in an apartment adjoining the patient's. The blood should be taken from the arm of a strong and healthy man. The quality cannot be unimportant, and in some recorded cases the failure of the operation has been attributed to the fact of the donor having been a weakly female. The supply from a woman might also prove insufficient; and, although it has been shown that blood from two or more persons may be used with safety, yet such a change necessarily causes delay, and should, if possible, be avoided. A vein having been opened, eight or ten ounces of blood are withdrawn and received into some perfectly clean vessel, such as a finger-bowl. As it flows it should be briskly agitated with a clean silver fork or a glass rod, and very shortly strings of fibrin begin to form. It is now strained through a piece of fine muslin, previously dipped in hot water, into a second vessel which is floating in water at a temperature of about 105°. By this straining, the fibrin and all air-bubbles resulting from the agitation are removed; if in no excessive hurry, straining may be done a second time. If the vessel be kept floating in warm water, the blood is prevented from getting cool, and we can now proceed to prepare the arm of the patient for injection.

This is the most delicate and difficult part of the operation, since the veins are generally collapsed and empty, and by no means easy to find. The best way of exposing them is that practised by McDonnell, who pinches up a fold of the skin at the bend of the elbow, and transfixes it with a fine tenotomy knife or scalpel, so making a gaping wound in the integument, at the bottom of which they are seen lying. A probe should now be passed underneath the vein selected for opening, so as to avoid the chance of its being lost at any subsequent stage of the operation. This is a point of some importance, and from the neglect of this precaution I have been obliged to open another vein than that originally fixed on. A small portion of the vein being raised with the forceps, a nick is made into it for the canula.

Injection of the Blood.—The prepared blood is now brought to the bedside, and the apparatus having been previously filled with blood to avoid the risk of injecting any bubbles of air, the canula is inserted into the opening made in the vein, and transfusion commenced. It should be constantly borne in mind that this part of the operation should be conducted with the greatest caution, the blood introduced very slowly, and the effect on the patient carefully watched. The injection may be proceeded with until some perceptible effect is produced, which will generally be a return of the pulsation, first at the heart and subsequently at

the wrist, an increase in the temperature of the body, greater depth and frequency of the respirations, and a general appearance of returning animation about the countenance. Sometimes the arms have been thrown about, or spasmodic twitchings of the face have taken place. The quantity of blood required to produce these effects varies greatly, but in the majority of cases has been very small. Occasionally two ounces have proved sufficient, and the average may be taken as ranging between four and six; although in a few cases between ten and twenty have been used. The practical rule is to proceed very slowly with the injection until some perceptible result is observed. Should embarrassed or frequent respiration supervene, we may suspect that we have been injecting either too great a quantity of blood, or with too much force and rapidity, and should desist until the suspicious symptoms pass away. It may happen that the effects of the transfusion have been highly satisfactory, but that in the course of time there is evidence of returning syncope. This may possibly be prevented by the administration of stimulants, but if these fail there is no reason why a fresh supply of blood should not again be injected, but this should be done before the effects of the first transfusion have entirely passed away.

Secondary Effects of Transfusion.—The subsequent effects in successful cases of transfusion merit careful study. In some few cases death is said to have happened within a few weeks, with symptoms resembling pyæmia. Too little is known on this point, however, to justify any positive conclusions with regard to it.

[Transfusion with defibrinated blood was, I believe, first tried in America by Dr. Joshua G. Allen, of Philadelphia, on December 30, 1868, on a woman who suffered from the effects of repeated attacks of uterine hemorrhage. Six fluidounces were injected, and the patient recovered a reasonable degree of health. In 1869, Dr. Allen repeated the operation four times, in two of the cases being associated with Dr. Thomas G. Morton at the Pennsylvania Hospital, and using a double vessel for keeping the blood warm, consisting of a conical cup for holding the blood and a lower vessel for containing warm water, the two being made in one and the temperature ascertained by an outside thermometer. Dr. Morton repeated the experiment on two other patients in 1870 and 1874, the second, a girl of eleven, being operated on twice, at intervals of six weeks, for bleeding from the nose and bladder, the effect of purpura; she entirely recovered. Dr. M. used a set of instruments specially designed for the work, and shown in illustration in the *Amer. Journ. of the Med. Sciences*, July, 1874, p. 112. Between 1874 and 1886 he repeated the operation on several hospital and private patients.

Intra-venous saline injections are far more readily used, are safer, and are believed from the tests that have been made to be quite as efficacious as blood. What has been called artificial serum consists of 20 grammes of sulphate of soda and 10 grammes of chloride of sodium in 2 litres of water. The solution should be injected into a large vein slowly and in large quantity, as much as a pint or more at a time, and repeated at intervals; the fluid should be blood-warm. Another formula consists of pure common salt 1½ fluidrachms, liquor potassæ 1 minim, and pure carbonate of potash 45 grains in two quarts of water.—Ed.]

PART V.

THE PUERPERAL STATE.

CHAPTER I.

THE PUERPERAL STATE AND ITS MANAGEMENT.

Importance of Studying the Puerperal State.—The key to the management of women after labor, and to the proper understanding of the many important diseases which may then occur, is to be found in a study of the phenomena following delivery, and of the changes going on in the mother's system during the puerperal period. No doubt natural labor is a physiological and healthy function, and during recovery from its effects disease should not occur. It must not be forgotten, however, that none of our patients are under physiologically healthy conditions. The surroundings of the lying-in woman, the effects of civilization, of errors of diet, of defective cleanliness, of exposure to contagion, and of a hundred other conditions which it is impossible to appreciate, have most important influences on the results of childbirth. Hence it follows that labor, even under the most favorable conditions, is attended with considerable risk

The Mortality of Childbirth.—It is not easy to say with accuracy what is the precise mortality accompanying childbirth in ordinary domestic practice, since the returns derived from the reports of the Registrar-General, or from private sources, are manifestly open to serious error. The nearest approach to a reliable estimate is that made by the late Dr. Matthews Duncan,[1] who calculated, from figures derived from various sources, that no fewer than 1 out of every 120 women, delivered at or near the full time, died within four weeks of childbirth. This indicates a mortality far above that which has been generally believed to accompany childbearing under favorable circumstances. It, however, closely approximates to a similar estimate made by McClintock,[2] who calculated the mortality in England and Wales as 1 in 126; and in the upper and middle classes alone, where the conditions may naturally be supposed to be more favorable, at 1 in 146; more recently he had come to the conclusion from his own increased experience, and the published results of the practice of others, that 1 in 100 would more correctly represent the rate of puerperal mortality.[3] In

[1] The "Mortality of Childbed," Edin. Med. Journ., vol. 1869-70, p. 399.
[2] Dublin Quarterly Journ. of Med. Science, 1869, vol. xlviii. p. 256.
[3] Brit. Med. Journ., 1878, vol. ii. p. 215.