has just begun to be used in the actual search for carriers. It seems a most promising method for the rapid survey of suspicious colonies or of subcultures or both.

As to subculture mediums, we have tried various carbohydrate combinations. Of these a serum-water agar containing 1 per cent. of lactose and 1 per cent. of saccharose and 1 per cent. of the Andrade indicator with the reaction set to this indicator seems to be the most promising for exclusion of the mouth cocci, the majority of which ferment one or both of these carbohydrates.

The applicability of the slide reaction as well as its value as a final identification method can be determined only in actual practice. Several factors will have to be determined: first, possible meningococcus strains not influenced by the serums used; second, the possibility of spontaneous agglutination among strains fresh from the human body, and third, false positive reactions due to the action of normal or group agglutinins on bacteria other than meningococci. If the case strains, however, are available and agglutinate well, this would raise a strong presumption that the strains from contacts which do not agglutinate could be excluded from consideration. Should a negative reaction be found reliable, but false positives be found, even then the time and labor saved would be very great. If the method is found to be of value, it is suggested that a central laboratory undertake to reserve for this purpose, serums showing the combination of the highest obtainable agglutinative titer as well as the widest possible strain range and have it available for call, labeled with dilution to be used. The amount required would not be large, as the dilutions need not be freshly made every day, and probably if kept in the refrigerator would remain fully active for a week or longer.

The serum drops with culture added, if allowed to dry, have as far as tried served as satisfactory smears for the Gram strain, thus avoiding the necessity of making extra smears for morphologic examination. It is probable that the agglutination result could be sufficiently checked by finding, on morphologic examination of the smear, typical gram-negative cocci showing the characteristic irregularity in size and intensity of staining ("autolysis") if a check is found necessary to exclude false reactions due to other bacteria.

Besides the application in identification, possibly the slide agglutination may find application as a simple method of testing the serum employed in treating a case against the case strain. This could be done within from eighteen to twenty-four hours of seeing the case and might serve not only as a check on the therapeutic action of the serum but might also give an easy method of determining the incidence of strains acted on by the serum, thus alining them with the standard strains employed in immunizing the horses. Should a strain not be influenced it might then with further experience indicate the advisability of obtaining other serums to select one showing such activity if procurable. A simple test would be more apt to result in the submission of aberrant strains so that they could be fully studied in relation to the problem of making the curative as effective as possible against the great majority if not all of the strains encountered.

NOTE ON PLATING MEDIUMS

Dr. William H. Park has just returned from Europe, and has brought a note from Gordon on a simple method for preparing a blood solution to be added to agar for growth enrichment. As this method is not included in the paper of Gordon, Hine and Flack,[1] he suggested that it be noted here. The blood is obtained under aseptic precautions by bleeding a rabbit from the carotid directly into 50 c.c. of 5 per cent. citrate in physiologic sodium chlorid solution. This is then diluted with physiologic sodium chlorid solution to give a content of 5 per cent. of rabbit's blood. Ether (10 per cent.) is then added and the whole shaken and allowed to sediment for twenty-four hours. The clear (hemolyzed blood) fluid is then drawn off and bottled, a little excess of ether being added to each bottle. Four c.c. of this blood is added to each bottle of agar after melting and cooling to 50 C. Each bottle of agar evidently means 200 c.c., as the reference quoted above states that this is the sized container of agar distributed from the central laboratory. Each time the bottle of blood is opened, a few drops of ether should be added before replacing the stopper. Of all the agar preparations used, that prepared from a trypsin broth from fresh ox hearts has been most satisfactory. The method of preparation is given by Gordon, Hine and Flack.[1]

SODIUM CITRATE BLOOD TRANSFUSION

A COMPARISON *

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The subject of blood transfusion has occupied the attention of medical men for a number of years and has been discussed at recent meetings of this association with increasing interest as the therapeutic importance of the procedure has become more generally recognized. Carried out at first only at rare intervals, and with fear and trepidation, because of its formidable operative difficulties, simplification of technic became the order of the day as the desirability of blood transfer from one individual to another became more apparent until, far from being an extraordinary procedure, blood transfusion has gradually become an everyday occurrence in the activities of most large hospitals.

Even so, until recently there remained difficulties in transfusion work of such nature that a high order of skill and a peculiar technical familiarity were required in order to achieve the best and most far-reaching results—and this in spite of the many brilliantly conceived and executed mechanical devices. Chief of these difficulties was the persistent tendency of the blood to clot, so that it came to be generally agreed that no method of transfusion could be finally satisfactory unless this element of coagulation should be entirely eliminated. Until the recent work of Hustin, Lewisohn, Weil and Agote, this desideratum seemed to be far in the future.

These workers, independently of each other, demonstrated that blood could be inhibited from coagulating for many hours, even as long as forty-eight hours, by mixing with it sodium citrate; and by animal experimentation, they further showed that if the dosage of the drug were carefully controlled, citrated

1. Gordon, M. H.; Hine, T. G. M., and Flack, M.: Cultural Requirements of Meningococcus, Brit. Med. Jour., 1916, **2**, 678; abstr., THE JOURNAL A. M. A., Dec. 23, 1916, p. 1972.

* Read before the Section on Surgery, General and Abdominal, at the Sixty-Eighth Annual Session of the American Medical Association, New York, June, 1917.

blood could safely be used for transfusion purposes. The fact that sodium citrate, and other chemicals, such as the oxalates, had long been known to scientists as possessing the property of retarding blood coagulation, detracts no whit from their work, since the drugs previously had been considered of such toxic nature as to render them unfit for human usage. I dare say that no set of experiments in recent years has been so productive of revolutionary changes in a single procedure and of more far-reaching results than have those of Dr. Lewisohn in which he worked out on animals the exact dose of sodium citrate that might be used with safety in carrying out blood transfusion in the human body.

But it was not sufficient to procure a noncoagulable blood. It was necessary to prove that citrated blood possessed powers of benefit equal to those of whole untreated blood, for by the time this new method had been developed, a sufficient number of successful whole blood transfusions had been recorded to give rise to reasonable demands for favorable results. Unfortunately, certain early misdirected applications of the new method ended disastrously, and cast a doubt on the method that retarded its adoption, but its inherent simplicity and many attractive features were sufficiently apparent to those most familiar with work of this nature to insure its ultimate general use.

To be able to remove blood from the veins of one individual and carry it in a flask to the bedside of another, many miles distant, maybe, and in a leisurely manner to introduce it into his veins with no more disturbance than would be required in giving ordinary intravenous salt solution, is no mean advantage. To be able to relieve the timid patient and the anxious relative from the necessity of going to the operating room and lying side-by-side while the blood of one flows or is syringed into the veins of the other is highly to be desired. What a boon it is to the patient, shocked and bleeding from any one of the various causes of hemorrhage, to receive into his veins life-saving blood without having to be moved from his bed or even turned! Are there any among us who have not seen certain of these unfortunates suddenly expire during transport, even in their beds, to the operating room? And in those instances of transfusion in septic conditions—of which typhoid fever is a type—the citrate method absolutely removes all possibility of infecting the donor. These and other minor advantages give to the method of sodium citrate blood transfusion a degree of elasticity not approached by any other. Even if the action of citrated blood were less beneficial than whole, untreated blood, these advantageous characteristics of the new method would be of important consideration, but we are additionally fortunate in being able to state that there is little if any difference at all. In making this assertion, which will be supported by definite case reports, I may be permitted to say that, having had a certain share in the present day development of blood transfusion and having devised certain instruments for the transfer of whole untreated blood, I have been, in the nature of things, a harsh critic of the sodium citrate method; but so convinced am I of its tremendous superiority over all others, that for the last year it has been my method of choice, and I have used it in practically every case that has come under my care.

If we eliminate errors of technic whereby an inexpert operator may add too small an amount of citrate to the volume of blood withdrawn, with the result that coagulation sets in before the blood can be given to the patient, there is only one unpleasant phase of citrate transfusion that is not so frequently encountered in dealing with whole blood; namely, the occurrence of a chill and fever following the blood introduction. In my experience a chill of an intensity varying from a slight sensation of cold to a terrific shivering and shaking occurs about twenty or thirty minutes after the blood introduction in about 22 per cent. of sodium citrate transfusions. During this reaction the temperature may abruptly rise as high as 104 or 105 F., and as abruptly fall to or below normal. The whole phenomenon is over in three or four hours, and the patient shows little or no ill effects from it. A few patients have been rather upset and nervous for a half day, but the majority have only the recollection of a bad hour or two. I have never seen more than a single chill after a transfusion, and I have never noticed the slightest harmful effect on the future course of the illness or the progress of the patient. Never has there been the slightest hemoglobinuria produced as a result of the chill. In practically every one of my cases most careful preliminary tests have been made by men peculiarly skilled in this work and perfectly matched donors have been selected with the purpose of avoiding this chill—all unavailing from this point of view. It occurs in spite of the tests, and, unless it is due to the chemical itself, its etiology is as obscure to me as its occurrence is without significance other than inconvenience to the patient. In this, then, the citrate transfusion differs from the whole blood transfusion, by which method my cases show that only 2 per cent. experience chills. The occurrence of this citrate chill, though, must not be regarded too seriously, since it must be remembered that the same phenomenon may follow the intravenous introduction of the ordinary isotonic salt solution.

The occurrence is unfortunate, especially because it cannot be predicted, and one can readily see good reasons for hesitating to subject a patient, shocked and almost moribund, to the possibility of an added trial of this nature. It has been suggested that an extremely slow introduction of the blood might avoid the chill by allowing the body time and opportunity to take up and eliminate the sodium citrate (the work of Salant and Wise would suggest this) but I have known it to follow after the slowest kind of transfusion, and fail to follow after an introduction of 500 c.c. of blood covering only seven minutes. Others have thought that the temperature of the blood may influence its occurrence but my experience fails to reveal any such cause. After I had watched a very ill patient recover without any untoward effect from the chill and had seen others escape it entirely, my early hesitancy to adopt the method disappeared and I now disregard this feature entirely. I really believe that even the extremely ill patients will not be harmed if it occurs, because it comes practically always after the transfusion is completed, and the dose of blood given will amply fortify them against the shocking effects of a possible chill. I have had only one case of chill during transfusion, and this does not offer a fair example, since it was an emergency of such dire necessity that preliminary tests could not be made. The chill, therefore, might have been due in part or altogether to blood incompatibilities.

My series of sodium citrate transfusions comprises forty-five consecutive cases and embraces a wide variety of conditions. The ages of the patients varied

from an infant of 8 days to a woman of 61 years, and both sexes had full representation, although the majority of patients were women. There were no deaths directly attributable to the transfusion, although death followed ten minutes after the blood introduction in one instance, and about an hour and half later in the two others. Two of the patients were unconscious and moribund at the time, and absolutely beyond the aid of transfusion or anything else, but, as occasionally happens in work of this nature, conditions peculiar to the case demanded measures of last resort even in the face of certain defeat. The first mentioned case was so hurried that blood tests could not be made. The second case was unavoidably delayed and the third patient died of hemorrhage in no way connected with the transfusion. In all other cases the beneficent influence of fresh citrated blood was as obvious as we were wont to experience when using whole untreated blood.

It might be thought that if sodium citrate prevents blood coagulation outside the body, a similar influence might be exerted in vivo and with disastrous results, but the contrary is the case. For example, late one night, I was called to see a little baby, 8 days old, who had had a ritual circumcision done some ten hours previously. There was a well-recognized family history of hemophilia, so after making every effort to stop the bleeding by ordinary surgical measures without success, I did a transfusion of 55 c.c. of citrated blood from father to child. In order to make doubly sure, I also dressed the child's penis in a gauze sponge soaked in the same citrated blood. The bleeding ceased immediately and the child made an uninterrupted recovery.

It has been well known, of course, that transfusion of whole blood usually acts as a specific in cases of this sort. It now appears that citrated blood is equally efficacious in the condition. But to illustrate its effectiveness in other states of active bleeding, I might say that in one case of bleeding gastric ulcer, and in another case of bleeding duodenal ulcer, a single citrate transfusion of 500 c.c. of blood in each instance effected a prompt and permanent cessation. Both patients were pouring out tremendous quantities of blood and were rapidly sinking at the time of the transfusion, six doses of horse serum having been administered to the patient with duodenal ulcer without the slightest beneficial effect. In still another form of active bleeding, in a most obscure case of a young girl apparently suffering from an intestinal type of purpura, a citrate transfusion returned to life an all but moribund patient. Her intestinal bleeding did not entirely cease, but the great outpourings of thin, watery blood were checked and a condition of hopefulness supervened on one of despair. Indeed, this case taught many lessons in the art of transfusion and afforded a rare opportunity to study the citrate method and to compare it with the whole blood method. Twelve transfusions in all were carried out on this patient during a period of three months—and with a most happy result. The first one, a citrate transfusion, did a tremendous amount of good, but we thought that subsequent citrate transfusions were not quite so effective. We tried whole untreated blood twice, but the results were no better so far as totally checking the bleeding was concerned, although the absence of chill was an advantage. However, since several of the citrate transfusions had been unaccompanied by this phenomenon, we felt justified in going back to this method, because of its greater ease of accomplishment.

This case will be reported in detail at another time in collaboration with Drs. Baetjer, Miller and Burnam, but it might be mentioned here that we had occasion to use a certain donor twice, both times by the citrate method, and were surprised to find that his blood gave rise to no reaction at all the first time, while a severe chill followed the second introduction. Equal amounts of blood were used both times, the technic was precisely the same in all details, and the patient's condition was about the same, although one transfusion had intervened between the two from this man, which were twelve days apart.

Aside from cases of actual bleeding, citrate transfusions have been used in several cases of secondary anemia with success equal to that of whole blood. One case was that of a woman, quite anemic from the prolonged gradual ooze of an ulcerated malignant growth of the uterus. Five hundred c.c. of citrated blood permitted her to withstand a radical operation without difficulty. Another instance was that of a man that had undergone a partial resection of the stomach for carcinoma. In bad condition before operation, his postoperative course was stormy, his abdominal wound broke open and showed no tendency to heal, he became progressively weaker, markedly anemic, and two weeks after operation was running a definite septic temperature. Unable to eat, dreadfully pale, his skin cold and clammy, hemoglobin registering but 22 per cent., this man presented the forlorn, despondent picture of one absolutely lost. Two transfusions of citrated blood at eight day intervals brought about a marked improvement, and the man walked out of the ward within three weeks able once again to take up his daily activities. In still another case, a citrate transfusion prior to and during operation permitted the removal of a ruptured kidney from a little boy who had been almost exsanguinated by the torn organ.

Quite recently, an unusual opportunity to compare the efficacy of whole blood and citrated blood presented itself. The case was that of a woman suffering from pernicious anemia, who had undergone early in 1916 three transfusions of whole blood and a splenectomy. She had left the hospital in very good condition and continued to be well for about eight months, when a relapse had set in. Unwilling to take the advice of her physician and have a supportive dose of blood, she gradually lost ground until she had a blood count of 1,331,000 red cells and 25 per cent. hemoglobin, at which time she consented to a transfusion. Having had experience with the whole blood method, she insisted that this should be used. She was given 500 c.c. of blood, and the count made two days later revealed 2,080,000 red cells and 35 per cent. hemoglobin.

I then persuaded her to permit me to use the citrate method for the second transfusion, which was done three days after the first, 500 c.c. of blood being given without the slightest sign of a chill or other discomfort. Three days later her count was 2,450,800 red cells and 45 per cent. hemoglobin, and a few days after this her red cells registered so high (3,700,000 and hemoglobin 55 per cent.) that the resident physician ordered the count verified. This case (and I have had others of a like nature) therefore demonstrates that citrated blood exerts as much influence on the blood forming organs as does whole blood.

I could cite details of other cases, but they would be only a rehearsal of those already mentioned. The upbuilding process in pernicious anemia is just as efficiently started by this method as by the whole blood; the combating of immediate postoperative hemorrhage and shock is likewise successfully carried out, and all cases are handled with surprisingly little discomfort to the patient. It is not even necessary for the patient to know that he is receiving blood (since a towel can be wrapped around the containing flask leaving the impression that the ordinary intravenous salt solution is being given. Finally, I have used citrated blood in amounts exactly corresponding to whole blood transfusions, the exact amount in a given case depending solely on the age of the patient, his condition, the amount of blood lost (if in a hemorrhage) and the purpose of the transfusion. The smallest amount given has been 55 c.c. to an infant 10 days old, the largest 1,000 c.c. to a woman exsanguinated from uncontrollable uterine bleeding. In several instances, with the patient under ether I have slowly injected sufficient blood to carry him through operation. And just recently I gave two transfusions to a little 22-month-old boy who was unconscious and thought to be dying from an anemia consequent on an unusually septic pneumonic process. The transfusions were given two days apart, the dose of the first being 140 c.c. and that of the second, 220 c.c., a tremendous dose for so young a child. No chill or other disturbance resulted from either transfusion, and the child was tided over an unusually critical period of his illness.

I, therefore, feel that a careful consideration of the foregoing pages will convince even the most skeptical that a tremendous advance was made when the method of sodium citrate blood transfusion became a reality. And those workers who had a share in perfecting it—Drs. Hustin, Weil, Argote, and especially Dr. Lewisohn—deserve the thanks and congratulations of us all.

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ABSTRACT OF DISCUSSION

DR. GEORGE I. MILLER, Brooklyn: Blood transfusion has passed the stage of infancy. It is of little importance today which method one employs to perform transfusion as long as he is able to perform the operation with ease, with accuracy and with safety to the patient. The physician who is called on to perform transfusion may well use his judgment and determine which method will be more convenient. He will surely be doing justice if he will discard all instruments in existence and resort to anticoagulation drugs for the purpose of preventing coagulation and in the hope of preventing operation. He may also be able to perform a blood transfusion by adding normal saline, equal parts, to any given quantity of blood and thereby prevent coagulation. Circumstances, however, may suggest different methods at different times. While anticoagulation drugs may be procured, prepared and then transfused in an institution, in the operating room or even in the patient's home, instruments for the transfusion can be used at all times and in every emergency, even in the highways in the country, on the farm, on the battlefield, in the trenches, wherever an emergency presents itself. I have performed 133 transfusions on 78 patients. Of these, 34 were for traumatic hemorrhages; from the kidney in 3; ruptured ectopic pregnancy in 2; postpartum hemorrhage in 4; placenta praevia in 3; excessive bleeding from hemorrhoids, 3; postoperative and intestinal hemorrhage, 4; gastric ulcer, 6; ruptured varicose ulcer of the leg, 1; hemophilia, 5; fibroids, 2; pulmonary hemorrhages, 1. Of the chronic cases, I have transfused for recurrent epistaxis, 4; purpura hemorrhagica, 5; psoriasis, 1; carcinoma of the breast, carcinoma of the uterus, preoperative carcinoma of the stomach, carcinoma of the eye, abdominal carcinomatosis, 1 of each; lymphosarcoma, 2; postpartum sepsis, 4; postabortive sepsis, 5; ulcerative endocarditis, 1; chronic furunculosis, 3; Banti's splenomegaly, 1; advanced simple anemia, 14; pernicious anemia, 40; postoperative shock, 4; cholemia, 1; melena neonatorum, 1; postoperative sepsis, 1; asthenia, 1; lymphatic leukemia, 2; hydatid mole, 2. I have had favorable results in these 78 cases. Of these there were 15 cases in which the outlook for recovery was poor and transfusion saved the patients' lives; 23 were cured, the lives of 20 were prolonged, and 20 died. I have used my own special method. I have devised two instruments; one is known as a valve and the other as a shuttle. The valve consists of two arms with rubber tubing and a stem. The stem of this instrument I attach to an ordinary record syringe used for salvarsan injections and by means of my special cannula, which I introduce into the vein of the donor, and couple to the arm of the valve, fill the syringe with blood, turn the lever and empty it into the empty vein of the patient. Having emptied the syringe, I come back to the arm of the donor, refill the syringe and take the desired quantity of blood. The second instrument is made on the same principle, except that it has no lever to turn back and forth, but the syringe goes back and forth from one arm to the other. I introduce the arm of the instrument into the vein of the donor, fill the syringe with blood and permit the syringe to move it instead of a lever, and empty it into the vein of the patient. I use a 100 c.c. record syringe. By going back and forth I get the desired quantity of blood. I have transfused 133 times with no bad results, without chill, without exposing the blood to the air, without paraffin, boiling the instrument the same as any other, and have not found it necessary to resort to any other method.

DR. RICHARD LEWISOHN, New York: It is rather surprising that sodium citrate, which has been used extensively as an anticoagulent in laboratory work, had never been made use of before for human blood transfusion. According to the textbooks on pharmacology, it requires at least a 1 per cent. mixture of sodium citrate to prevent coagulation of the blood. My experiments show that 0.2 per cent. is sufficient to prevent clotting, and furthermore, that if a 1 per cent. mixture is used in large transfusions, the clinical results will be most alarming and possibly fatal. These two new observations have put the citrate method of blood transfusion on a safe clinical basis. It should be our aim in surgery to simplify the technic as much as possible, if the simplified methods give us the same clinical results as the more complicated ones. There can be no doubt that the citrate method is technically much simpler than any of the other methods. Furthermore, this new method makes blood transfusion applicable in a number of diseases in which the other methods (vessel anastomosis, syringe and stopcock methods) could not be used on account of the risk for the donor (bacteremia, typhoid, etc.). Extensive experience has shown that citrated blood is clinically as efficient as unmixed blood, even in hemorrhagic diseases. Furthermore, citrated blood, within the limits mentioned above, is absolutely atoxic. I have repeatedly used rather large quantities of citrated blood in new-born infants suffering from melena neonatorum, omphalitis neonatorum, etc. The bleeding stopped immediately and the babies did not show even the slightest reaction. My records include 130 cases; of these, 15 per cent. had a chill following the transfusion. We encountered chills following the infusion of citrated blood somewhat more frequently than with the other methods (Unger about 5 per cent., Lindeman 10 per cent.). I do not think that the addition of sodium citrate to the blood accounts for the chills. They are probably caused by the chilling of the blood during the transfer from donor to recipient. I intend to use a thermos bottle of special construction in place of an ordinary glass jar, and hope thus to reduce the percentage of chills.

DR. J. BION BOGART, Brooklyn: Dr. Miller happens to be my associate at the Jewish Hospital and many of his transfusions have been done in my service and I have been a witness to them. If you hear an operator talk, his method seems easier than when you see it done. Now the Miller

method is just as easy as it looked when Dr. Miller demonstrated it here by drawing water into the syringe and changing from one receptacle to another. I want to take issue with the statement made by Dr. Lewisohn that there is no doubt that the citrate method is the simplest of all methods. I have the greatest admiration for Dr. Lewisohn and his method and I would be the last one to take exception to anything that might be said so long as it was true; but I am satisfied from having seen a large number of these transfusions that the Miller method is quite as simple and I believe I might truthfully say it is simpler than the citrate method. Any one who can introduce the cannula, use a syringe and turn the valve can make the transfusion. You saw the little box which Dr. Miller brought—about 4 inches long, 2 inches wide and 1½ inches deep. That is all you need. The donor has to be examined in the same way in both cases.

This matter of blood transfusion has reached a point at which there is no longer any discussion about its usefulness. Its field is widening all the time. I think it has reached the point as to which is the simplest method—simply a question of which can be done the easiest, and which all may be able to do; and I would advise every one of you before leaving this meeting to take in your hands the Miller valve and make the experiment of transferring water from one vessel to another with it. I think that will convince you that the Lewisohn method is not the easiest. My own judgment is that there are only two methods, the Miller method and the method by the citrated blood.

DR. J. SHELTON HORSLEY, Richmond, Va.: I regard the work of Dr. Lewisohn on transfusion as second in importance only to that of Crile and Carrel. Any surgical operation that is converted from a complicated technic into a simple procedure is the ideal in surgery, and this is what Dr. Lewisohn has done. He has taken an operation that is sometimes urgently necessary, and also a very complicated one as done according to the earlier technic, and converted it into such a simple thing that any one can do it. I confess I was somewhat skeptical about this method when it first appeared, but I have been converted by the results that have been shown.

There are some interesting features connected with the citrate method, however, that have not been explained and may have no practical bearing. We know that, according to Lewisohn, a 0.2 per cent. solution of citrate of soda will prevent blood from coagulating from one to two days, but when this citrated blood is introduced, the coagulation time of the patient's blood is always shortened. This shows that there is some product of injured cells released by the citrate method that formerly was not present. Thrombokinase, or some similar product that results from injured platelets or blood cells, is undoubtedly produced, for otherwise the coagulation time would not be shortened. It would be interesting to know just what happens to cause this phenomenon.

Comparatively little is known about the chemical changes in blood. Physiologic chemists are not agreed about so gross a process as coagulation. It is reasonable to suppose that some other changes that cannot now be detected occur in blood that is not performing its normal physiologic function. The turning loose of cell products by the citrated blood is an evidence that the material introduced is not the same as the blood would be if carried directly along a continuous channel of vascular endothelium, as in the direct suture method of transfusion. Clinically, however, these changes from citrated blood that tend to shorten the time of coagulation of the patient's blood, seem to be of no importance if the technic of Lewisohn is adopted. If the results are practically the same, the simpler method, of course, should be adopted.

DR. BERTRAM M. BERNHEIM, Baltimore: It must be nice to have Dr. Bogart say for one, "If you come down to the Jewish Hospital, we will show you." If you come to Baltimore, if you go to Mt. Sinai, if you go to Chicago, you can see still other methods; and if you go to Brown you will also see an instrument there which works perfectly, but they are all for whole blood and will not do. I sympathize with Dr. Miller because I devised two instruments myself. All my work is surgical. I hated to see the whole blood method go, because the citrated method introduced a tremendous amount of competition not encountered before. And thereby hangs a tale. The medical men have taken up citrate transfusion. The citrate method is open to all; but few can do a hurried, whole blood, emergency transfusion. I have done transfusing in a blacksmith shop when there was no other way. I have crawled up on the bed and transfused people, but I was pretty skilled in doing that transfusion, and have seen others try to do it and fail, even in a well equipped operating room. If one is going to use these instruments we have heard about, one has to use syringes. Dr. Miller's remarks were beside the point. This is neither the time nor place to demonstrate instruments. The subject under discussion was citrated transfusion as compared to whole blood transfusion. It cannot be denied, if one considers the matter, that the citrate method is the simpler. One must admit there is a great advantage in dealing with only one patient. In citrate transfusion the blood is taken from the donor and may be administered in New York, Baltimore or Chicago. It can be carried in a flask! Instruments are bad and must be relegated to the scrap heap.

STUDIES ON THE CAUSE AND THE TREATMENT OF BRONCHIAL ASTHMA *

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During the past two years at the Peter Bent Brigham Hospital, we have been investigating the cause of bronchial asthma and our study of its causation has led to a consideration also of the treatment of this disease. Because of the close relationship between the symptoms of bronchial asthma in man and those of anaphylaxis in animals, we have been interested chiefly in the part played by protein sensitization as a cause of bronchial asthma. A few words will outline the pioneer observations which have linked together the symptoms of these two conditions.

The earliest observation having direct bearing on protein anaphylaxis is found in the writings of Magendie in 1839. He describes the sudden death of dogs which had been repeatedly injected with egg albumin. The next observation was in 1894 by Flexner, who noted that animals would succumb to a second dose of dog serum if some days or weeks were allowed to elapse between the first and the second injections. Richet in 1902 made a systematic study of this problem and found that the first dose of protein was followed by a condition of markedly greater susceptibility to the protein. He called this phenomenon anaphylaxis to express its antithesis to prophylaxis or protective effects. As a result of many other investigators from this time on we now know that, when a specific antigen (a protein in the case of asthma and anaphylaxis) meets its antibody, the reaction between them gives rise to a toxic product and this causes the characteristic symptoms known as anaphylactic shock. In 1910 Meltzer pointed out that in both bronchial asthma and anaphylaxis the symptoms consist in a tonic stenosis of the small bronchioles and that both conditions are favorably affected by the administration of atropin.

From the work of many investigators we now know a considerable amount about anaphylactic shock in

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