small pieces like grains of rice. The glands of the neck, and the neck itself, are much less swollen, and the breath less offensive and the tongue clean. (I ordered castor oil to all the patients on my first visit.) The difficulty in swallowing is gone, and she feels altogether better.—Dec. 8th: No membrane. She got perfectly well.

CASES 15 and 16.—Two daughters of the last. Membrane on both tonsils, which disappeared on the thirteenth and fourteenth days. Both recovered.

CASE 17.—Mr. J. J.—'s daughter, aged thirteen—Membranous patch on right tonsil. Steam had been used directly she was attacked, twenty-four hours before I saw her. Recovered.

CASES 18 and 19.—Two sisters of the last. Membrane on both tonsils. Recovered.

CASES 20 and 21.—Younger sisters of Case 1. Very little membrane seen. Pharyngeal mucous membrane very congested and neck tender. Recovered.

CASES 22 to 26.—Mr. J.—'s five children, ages ten to twenty. Three of these cases were very severe. In the eldest the breathing was very much affected, and was very similar to Cases 1 and 2, and two, aged fourteen and sixteen, had the breathing also affected.—They coughed up the membrane after steaming.

CASE 27.—Miss R. A.—, aged ten, younger sister of Case 2, had a very severe attack, the whole back of the throat being covered. I saw her first on December 7th, and on the 20th her throat was clear of membrane.

CASE 28.—Bessie S.—, aged six, complained on the morning of November 28th of great pain in her throat and great thirst. The next morning a scarlatina-like rash extended from the navel to the knees, the throat and thirst being better. The rash remained out two days.—Dec. 3rd: Skin peeling in large flakes from affected parts, and also from tips of fingers; throat slightly inflamed.—8th: Both tonsils covered with diphtheritic membranes, mostly removable with brush.—13th: Membrane renewed daily; very little to-day. Recovered.

CASE 29.—Mr. M.—'s son, aged two.—May 3rd, 1882: Both tonsils covered with membrane; feverish; breathing easy.—4th: More membrane extending low down.—6th: Less membrane; removable. Recovered. A brother of this child died six hours after I first saw him, on Jan. 23rd, he being comatose and semi-asphyxiated.

CASE 30.—Mr. F.—'s child, aged ten.—Dec. 10th: Large patch of membrane on left tonsil. Had been inhaling steam four days. Recovered.

CASES 31 and 32.—Two sisters of last. Both tonsils covered; reappeared for thirteen days. Recovered.

CASE 33.—Mr. F.—'s child, aged four.

CASE 34.—Mr. J. C.—'s child, aged four.

CASE 35.—Mr. C.—'s child, aged five.

CASE 36.—Mr. J.—, aged twenty-two.

CASE 37.—Mrs. —, aged twenty-two.

REPORT OF TWO EXPERIMENTAL TRANSFUSIONS ON DOGS,

PERFORMED IN GUY'S HOSPITAL LABORATORY.

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IN previous communications I have endeavoured to draw a marked distinction between the indications for the intravenous injection of saline fluids and for the transfusion of blood, and have suggested that, whenever admissible, the former should be chosen in preference to the latter method, which is necessarily a complex procedure, and if imperfectly performed a dangerous one. Conceiving that the chief objection to direct transfusion lies in the risk of coagulation of the blood *in transitu*, I have published¹ the description of a syphon apparatus designed to remove this source of danger, by causing the donor's blood to mingle with more than an equal bulk of saline fluid, immediately after quitting the efferent cannula—i.e., on entering the connecting-tube. The chance of coagulation might be further lessened by

employing a saline fluid at about 75° F., instead of at blood-heat. The fluid, too, might contain a small percentage of ammonia, as an additional precaution. The vascular system of the donor could be replenished by the substitution of saline fluid for the blood transfused. With the view of determining these points, I have performed, by the courtesy of Dr. Pye-Smith, two transfusions in his laboratory at Guy's Hospital, one of the few places licensed for experiments on animals in the United Kingdom.

Experiment 1.—July 30th: The operation was performed under mixed narcosis, slightly modified from that figured in THE LANCET,² and charged with an ammoniated saline fluid.³ The small size of the animals, the donor weighing 15 lb. 9 oz., and the recipient 12 lb. 4 oz., involving the employment of cannulae smaller in bore than would be selected for the human subject, coupled with the greater tendency of the blood of the dog to coagulate, as compared with that of man, the anatomical relations of the jugular vein⁴ of the dog, and its close proximity both to the heart and to the brain, conspired to render the operation somewhat more difficult than it would be in actual practice. Transfusion was established between the right external jugular veins of the two dogs, the recipient being simultaneously depleted. Saline fluid was then substituted for the blood lost by the giver. The afferent cannula was of No. 1 size, the efferent No. 2.⁵ After the experiment the recipient was found to have lost 2½ oz. (this being the difference between the blood lost by venesection and the mixed fluid gained by transfusion), and the giver to have gained 1½ oz. in weight (due to the saline liquid injected). About 10 oz. of saline fluid had been injected into the dogs, and about 3 oz. of blood were collected from depletion of the receiver, besides about half an ounce which was lost. The donor, whose vessels were surcharged, began moving about the more briskly on recovering from the anæsthetic. The recipient, which had been more deeply anæsthetised than the giver, also recovered perfectly, though continuing drowsy from the effects of the morphia for some time. Both dogs were killed the same afternoon.

This experiment conclusively proved that blood would mingle rapidly and completely with saline fluid in the junctional tube of the instrument, and, so far as it went, showed—first, that coagulation of the blood did not occur in its passage from giver to receiver; nor were any coagula found within the instrument after the cannulae had been withdrawn from the veins of the animals; and, secondly, that the saline fluid facilitated the flow of blood, and could be directed into the vein of either dog at will.

The experiment showed, further, that to tap the vein of the donor with a trocar and cannula, as proposed, is impracticable. Unless they be made to fit each other with extreme accuracy, I am convinced that a trocar and cannula would be useless for transfusion purposes. On grounds of convenience I tried the trocar; by having devised a phlebotome (Fig. 1), which greatly facilitates the insertion of cannulae into veins, I have discarded the former instrument as unnecessary. Therefore a modification of the apparatus, in the direction, of simplicity has been made. This must be described in detail before narrating the experiment in which it was employed.

The phlebotome is a small instrument, combining the advantages of a knife, hook, and director. Its blade, which is pen-shaped, is set at a right angle to the shaft. The upper surface of the blade is slightly convex both from side to side and from before backwards. The anterior third of the lower surface is plane, the middle third slightly concave from side to side, and the posterior third deeply so, in order to afford a suitable guide for the cannula. As in making a corneal section for cataract with a Beer's knife the aqueous humour cannot escape, so in puncturing a vein with this phlebotome, provided only the anterior third of the blade of the instrument be introduced within the vessel, no blood can emerge. Fig. 3 shows an enlarged view of the junctional tube interpolated in the syphon (Fig. 2) at C. The efferent cannula is intended to plug on to the aperture (D). Communication can be established or cut off between the efferent cannula and the junctional tube by partially withdrawing or closing the inner tube (E). A mechanical arrangement exists to prevent the outer and inner tubes from coming

² Loc. cit.

³ Vide On Transfusion of Blood and Saline Fluids (Baillière, Tindall, and Cox).

⁴ This being the vein chosen for the experiment.

⁵ Cannulae have been made for me of the following sizes, No. 3 having the largest calibre:—3, 2, 1, ½, ¼.

entirely apart.⁶ In the preceding experiment, a junctional tube of glass, with the communication between it and the efferent cannula not capable of being made or broken at will, was employed. The fact that the blood and saline fluid would satisfactorily mingle having been determined by observation through it, the necessity for a junctional tube of glass, instead of metal, no longer existed.

Experiment 2.—Aug. 8th: The syphon was charged from a receptacle of saline fluid (78° F.), each pint of which contained ten minims of liquor ammoniæ, and the following salts in solution:—Chloride of sodium, 50 grs.; chloride of potassium, 3 grs.; sulphate of soda, 2.5 grs.; carbonate of soda, 2.5 grs. The communication between the efferent cannula and junctional tube was shut off. The experiment was performed, like the last, under mixed narcosis. The recipient weighed 20 lb. 1½ oz.; the donor, 15 lb. 1½ oz. Immediately after the (left) external jugular vein was exposed, its sheath was opened with the scalpel.⁷ The wall of the vein was punctured, and slightly elevated with the phlebotome, the afferent cannula (No. 2 size) being quickly introduced beneath it. The cannula was secured *in situ* with a ligature. After a lapse of some time it occurred to me that a coagulum might already have formed about the aperture of the afferent cannula, from blood within the receiving vein, saline fluid not having been allowed to flow, since the dog was not yet depleted. The removal of the cannula to ascertain this point proved that such was the case. The coagulum having been removed, the cannula was reintroduced within the vein, and the formation of a fresh coagulum provided against by allowing saline fluid to pass *guttatim* at short intervals. Depletion from the vein on the

made to assume. When the first convulsion of the facial muscles of the donor occurred⁹ the flow of blood was arrested by suddenly increasing the pressure of the saline, which now entirely displaced the blood in the instrument. The flow through the afferent cannula was stopped, the saline fluid coursing through the efferent cannula (B), and thus repleting the donor's vessels. The experiment was concluded by removing the instrument, and noting that no coagula existed within it. The quantity of saline fluid injected into both dogs was sixteen ounces, only two ounces of blood had been collected from the depletion of the receiver in a vessel, but some had been lost. Some blood was lost from the donor's vein, and also some saline fluid by slight leakage from the junctional tube.¹⁰ The receiving dog, which had gained five ounces¹¹ in weight by the experiment, recovered, though it remained drowsy from the effects of the morphia for some time.

In order to test the instrument further an additional experiment was performed on the donor, still anaesthetised. The efferent cannula of the syphon, charged with saline fluid, was inserted into this dog's left jugular vein, the animal being depleted through the connecting-tube. The blood, on passing the afferent cannula, mixed with saline fluid from the syphon, was received under fluid. A slight convulsion occurring, the dog was repleted with saline fluid, then more blood was drawn and saline substituted for it. The quantity of blood and saline fluid mixed, which was collected in the basin after this experiment, measured nine ounces; the total quantity of saline fluid employed was fourteen ounces. The jugular vein and other bleeding points were ligatured and the wound closed with sutures. A little

distal side of the cannula was effected, but the flow of blood was tardy. By opening the sliding tube (C), the rubber tubing being closed near the afferent cannula (A) by the burette clip, the saline fluid emerged from the efferent cannula (B). The flow was now arrested by the stopcock, and the efferent cannula (No. 2 size) was inserted into the right external jugular vein of the donor. The cannula being of a conical form, it was first maintained *in situ* by pressure; but blood escaping by the side of the instrument, it was finally secured with a ligature.⁸ On relaxing the pressure made on the tubing by the burette-clip the donor's blood rapidly passed through the connecting tube, pressing the saline contained therein onwards. The contents of the glass interruption rapidly became of a deep mulberry colour. Mr. Golding-Bird, who at this moment kindly regulated the stopcock for me, turned on a little fluid. The chief interest in the experiment lay in allowing the saline fluid to mingle with the blood in various proportions, the amount of the dilution of the blood being obvious by the various and rapid changes of colour the fluid in the glass tube (F) could be

blood mixed with saline fluid had been left in the connecting tube of the syphon. On being now examined coagulation had begun. The dog was then allowed to recover and run about. It had lost half an ounce in weight by the two experiments. Both animals were soon afterwards killed. It was suggested that possibly the saline fluid infused into the dogs had transuded from their vessels their serous cavities. To ascertain whether this fallacy existed, the peritoneal, pleural, and pericardial cavities of the animals were examined post mortem, but no effusion was found.

For valuable assistance in the first of these experiments, I am indebted to Dr. Fenton-Jones, and in the second to Dr. Golding-Bird. Nor must I omit to state that the success of the experiments was largely due to the admirable physiological appliances which were placed at my disposal.

Propositions:—1. That by this method there is no danger of coagulation of the blood occurring *in transitu*, if ordinary care be observed in the performance of the operation. 2. That to substitute saline fluid for transfused blood is practicable. 3. That depletion, with simultaneous transfusion, is indicated in some cases of poisoning, notably opium poisoning, and, probably, for many conditions not yet determined, by this process, the vitiated blood being removed and the equilibrium of the vascular system restored. 4. That if, in any case, the admixture of more than an equal bulk of saline fluid with the blood in the connecting tube of

⁶ This contrivance is omitted from the diagram, which is of small scale, in order to prevent confusion. The telescopic tube employed in the forthcoming experiment was a brass model, very hastily made for me by Kröhne and Sesemann.

⁷ In order to avoid the chance of introducing the phlebotome between the sheath of the vein and its anterior wall. One other possible error might be committed, which need only be known that it may be avoided—viz., the phlebotome might be thrust through the posterior as well as through the anterior wall of the vessel, and the cannula introduced between its posterior wall and its sheath.

⁸ The absolute necessity of ligating cannulae within veins was thus demonstrated. In actual practice this step, though painful to the donor, should never be omitted.

⁹ This took place quickly, since the blood was flowing directly from the nervous centres.

¹⁰ The tube employed being a rough model, but tubes similar in outline have since been made free from this fault.

¹¹ The transfusion being so much in excess of the depletion.

the instrument be objectionable, fibrination may still be prevented by employing a smaller proportion of a more highly ammoniated solution than was used in these experiments.

[I receive confirmation in the belief that the syphon principle on which my instrument is constructed is the right one by the fact that it has been adopted by no less an authority

than M. Roussel. The above diagrams show, first, M. Roussel's well-known instrument; and, secondly, his modification of it, which has been illustrated in a recent number of the *Journal de Médecine de Paris*.]

AN ACCOUNT OF THE GENERAL HOSPITAL, INDIAN DIVISION, EGYPTIAN EXPEDITIONARY FORCE, AT SUEZ,

FROM AUG. 25TH TO OCT. 13TH, 1882.

By BRIGADE-SURGEON J. H. THORNTON, I.M.D.,
LATE IN MEDICAL CHARGE OF THE GENERAL HOSPITAL, INDIAN
DIVISION, EGYPTIAN EXPEDITIONARY FORCE AT SUEZ.

As public interest has been so much aroused by the recent inquiry into the state of the hospitals at Ismailia and Cairo during the late Egyptian campaign, a short account of the General Hospital of the Indian Division at Suez may not be out of place, especially as this hospital has hitherto remained almost entirely unnoticed. It was at first established in the buildings of the Victoria Hospital at Suez, but on Aug. 27th, 1882, it was removed to the P. and O. steamer *Hydaspes*, in Suez docks. The number of sick transferred to the *Hydaspes* was as follows:—

Sick of British troops (2nd Batt. Seaforth Highlanders)	10
Sick of Native troops	16
Sick of Native followers	3
Total	29

The *Hydaspes* had brought over cavalry, and was entirely unprepared to receive sick, as the horse-fittings had not been removed from her main deck. By the kindness of Captain Hext, R.N., Superintendent of Naval Transport at Suez, I obtained the services of some carpenters, who at once proceeded to remove the horse-fittings and to fit out the main deck with beds, &c., in accordance with my directions. The sick were kept on deck as much as possible while this work was going on. The *Hydaspes* is a steamer of 2984 tons, 375 feet in length and 38 feet broad; she has a flush deck fore and aft, with plenty of space, and a main deck provided with numerous large ports admitting free ventilation. A considerable part of the main deck is occupied by the engine-room and boilers, but there is a large space in front and on each side. This space was used for the hospital, and 100 wooden beds were constructed in it of such height as to place the occupants almost on a level with the ports, so as

to get the utmost advantage from the breeze blowing through them. Fifteen of these beds, on the port side of the ship, were entirely separated from the rest, and were devoted to the use of the sick European soldiers and their attendants, while the remaining beds, eighty-five in number, were given to the native sick. The orlop decks, fore and aft, were also placed at my disposal, but were only used for stores, as they were unsuited for hospital purposes, having no ventilation except through the hatchways. A small dispensary was constructed on the main deck close to the fore hatchway, and an operation table was made. This was surrounded by canvas curtains so as to form a room for operations, examination of patients, and such like purposes. When not in use the curtains were rolled up so as not to interfere with ventilation. The situation of the ship was very convenient; she was moored close to the sea wall on the south side of the Suez docks, and presented her broadside to the prevailing wind, which blew through her large ports, ventilating the main deck so thoroughly that even at night, when every bed was occupied, I found on visiting the hospital that the air was sweet and not the slightest odour perceptible. As she was close to the shore and provided with suitable gangways, I ordered all cooking to be done on land, and I had latrines dug at a short distance, instead of allowing the ship's latrines to be used. By these means, and by the liberal use of disinfectants in the hospital, the sanitary condition of the ship remained perfectly good from first to last. Condensed water was supplied to the sick from the ship's condensers; the supply was ample and of good quality. The rations supplied by the commissariat department for the use of the sick were of good quality throughout, and I had no occasion to find fault with anything. Although the heat in the daytime was considerable, the thermometer on deck frequently indicating a temperature of 100°, the nights were cool and pleasant, and the climate appeared to be very healthy. The sick rapidly improved, especially those sent down from the front, and hardly any cases took an unfavourable course. It was at one time proposed to bring up the *Hydaspes* to Ismailia; but, taking into consideration the superiority of the climate and sanitary conditions at the Suez docks and the convenient situation of the ship, I recommended that she should be allowed to remain where she was, and that the sick should be sent down to her. This plan was ultimately adopted. In a short time the available space in the *Hydaspes* was all occupied, and the sick subsequently received were accommodated in tents, which were pitched on the shore at a short distance from the ship. Early in October orders were received for the removal of the hospital from the *Hydaspes*, as the ship was required for the transport of cavalry returning to India. Additional tents were accordingly obtained, and the hospital was removed from the *Hydaspes* to the tents, where it remained until all the sick were disposed of by transfer to their respective corps as they arrived at Suez on their way back to India. The sick native followers, ninety-four in number, were placed on board the transport *Avoca*, under my charge, for conveyance to Bombay. They nearly all recovered during the voyage; only one of them died at sea; and the few remaining sick on arrival at Bombay were sent to the hospitals of that city. The total number of patients treated on board the hospital ship *Hydaspes* from Aug. 27th to Oct. 11th was as follows:—

Officers	3
Sick of British troops (2nd Batt. Seaforth Highlanders)	10
Sick of Native troops	130
Sick of Native followers	180
Total	323

The principal diseases among the fighting men were ague, dysentery, and venereal affections. Very few of the cases were severe, and none proved fatal. Some cases of conjunctivitis occurred, but none of them were of a severe type. There were four cases of gunshot wounds, of which only one (a gunshot wound of the right forearm, missing the bones) could be considered severe. There was also one case of sword wound of the chest, in which only trifling injury had been inflicted. A few cases of bronchitis, pneumonia, and pleurisy were received, mostly slight, and requiring no particular notice. One of the officers suffered from typhoid fever, probably contracted on board the transport in which he came from Bombay to Egypt; his case was serious, but