explained to you, how to go about it? Any or *all* of the various Nursing Associations in India, now existing or to be formed in the future, can simply affiliate under our Committee or group of Executive Officers, and among themselves collect the fee to be paid to the International which, as you see, is very moderate. This leaves all your various associations entirely free in their ordinary work and objects. They simply unite *for* the *one* purpose of entering international relations. No formal constitution is necessary, just two or three simple articles or bye-laws to state the international purpose and to arrange for the sharing of fees. Your regular letter of application ought to be in the hands of our Councillors in time for their action on the day before the regular CONGRESS, IN JUNE, 1912. We then act on it and recommend your admission for the vote of the Assembly. I so hope that many of you will be able to come to the meeting.

Believe me, sincerely yours,

L. L. DOCK.

Secretary I C N

Will any members or subscribers who may have duplicate copies or who may not be keeping their set of Journals, and have by them the following numbers, very kindly post them to Mrs. Barr? Owing to slightness of wrapper, many copies never reached their destination and we have constant application for duplicate copies which unfortunately we are out of, Numbers, *December 1910, January, February and March of current year* are urgently required.

SERA AND SERUM THERAPY.

BY CAPTAIN HUTCHESON, I.M.S.

IN our article on Vaccines and Vaccine therapy, we saw how Vaccines were used in the prophylaxis and treatment of disease, and how, in vaccination, the body had to manufacture its own protective substances. In Serum Therapy, on the other hand, the protective substances are manufactured by some other animal and are injected into the human body when required.

Sera are of two kinds—antitoxic and antibacterial. The former are produced by inoculating animals with the toxins of a bacillus, while the latter are produced by inoculating with the bacillus itself. In the former case, the toxins of the bacillus are neutralised by the antitoxic serum, leaving the body to deal with the bacteria, while, in the latter case, the antibacterial serum acts direct on the bacteria.

PREPARATION OF ANTITOXIC SERA.

These are prepared by injecting the toxins of a bacillus, and, as an example of this class, the Diphtheria bacillus may be given. The

bacillus is grown for several days on a suitable medium such as peptonised beef broth. Special flasks are used for this bacillus so that a large surface may be exposed to the air, it having been found that the bacillus produces the maximum amount of toxins under these conditions. When the growth is completed, the medium is filtered, and in this way a filtrate of diphtheria toxin is obtained, the bacilli themselves being left behind in the filter. The next step is the injection of the toxin in an animal, the horse being chosen for several reasons—its easy management, good re-action, and large yield of serum. Before injection, the strength of the toxin must be determined, because if the initial dose is too large, fatal results may follow. The testing is carried out on guinea-pigs. Having determined the strength of the toxin, a small suitable dose is given and slight re-action follows, both locally at the seat of injection and also constitutionally—fever, loss of appetite, and malaise. This soon passes off and after a few days a second dose is given, and when the effect of this has passed off, a third still larger dose is given, and so on, till the blood of the animal has produced its maximum amount of antitoxin. The whole process is a long one and takes two or three months to complete, and in the end the horse may be able to stand doses of toxin which would kill 80, 100 or even more horses which had not been so immunised. The animal is then bled and several pints of blood are withdrawn. The blood is taken from the jugular vein and this is done by sterilising the skin over the part, making a small cut in the skin and by passing a canula into the vein. Needless to say, strict asepsis must be preserved throughout. The blood flows through a sterile rubber tube into a sterile glass. This glass is then laid aside in a cool place and the clot is allowed to separate. After a day or two, the serum is decanted off and after adding some antiseptic to preserve it, it is placed in bottles and sealed up. This serum contains the antitoxin, and before use it must be standardised as it will be obvious that different horses will not produce the same amount of antitoxin in their bodies. This leads us to the consideration of an "antitoxin unit". To test the strength of an antitoxin, guinea-pigs are used because they are handy animals and they re-act well to diphtheria toxin. Formerly, the antitoxin unit was determined as follows: the amount of toxin was first estimated which would kill a guinea-pig of 250 grams weight within 48 hours, and from this, the antitoxin unit was defined as the amount of antitoxin which would protect a guinea-pig from 100 fatal doses of toxin. This method is not quite accurate, because it has been shown that toxin solution may contain substances called toxoids which, though incapable of causing death, are still capable of combining with antitoxin and rendering

it inert. It is clear, then, that the toxin will vary with the amount of toxin and toxoid present. An antitoxin unit is now taken as the minimum amount of antitoxin which, when injected with a unit of *standard* toxin, delays death of the guinea-pig till after the 4th day. When any antitoxic serum has been obtained, varying amounts of it are mixed with standard lethal doses of toxin and are injected subcutaneously into guinea-pigs. From the results one can determine fairly accurately the number of antitoxic units in the serum.

I have refrained intentionally from giving a full description of antitoxic units as it would involve too much theory and would take up too much space. It is sufficient to remember the definition of an antitoxin unit, as the sera are issued marked with the number of antitoxic units in them, and one always refers to units in determining dosage.

This method of preparing sera applies to antitoxic sera and to antibacterial sera also except that, in the latter case, bacteria themselves are injected, while in the former the toxins or poisons of the bacilli are used. In both cases the same principles hold—to train the animal to stand large doses of poisons, in which case the serum of that animal contains large amounts of protective substances.

Having now considered in a general manner the preparation of sera, let us now pass on to the individual sera and consider them in detail.

Anti-diphtheritic serum or Diphtheria antitoxin.—The results obtained from the use of this serum are well known. Given first in the year 1894, successful results have increased year by year till now it is the only recognised treatment of this once dread disease. The dose to be given in a case of moderate severity must be large—not less than 2,000 units and in a severe case up to 4,000 units at the least. When the case is seen later, even larger doses must be given. No distinction is to be made between children's and adult's doses, in fact the children should receive larger doses as the disease is more fatal in them. The longer a case is in coming under treatment, the greater the dose must be. It has been abundantly proved that the earlier the antitoxin is given, the better will be the results obtained. It is clear, then, that in a doubtful case, it is unwise to delay injection of antitoxin till a bacteriological examination has been carried out of a swab from the throat. If it turns out to be diphtheria, good and well. If not, then no harm has been done. Since the introduction of this serum, the mortality has fallen from about 35% to below 10%, and it would fall still further but for the fact that many cases do not come under treatment till the disease has advanced. As is well known, tracheotomy used to be a common operation in diphtheria cases owing to the formation of a diphtheritic

membrane in the trachea. Prior to the introduction of the antitoxin, the mortality in tracheotomy cases was about 70% whereas, nowadays, it is between 20% and 30%. These figures speak for themselves.

Anti-tetanic serum.—This is an antitoxin serum, but, unfortunately, it does not give the results that were expected of it. The reason of this is that the symptoms of tetanus or lockjaw do not show themselves till the nervous system has been affected. The toxin remains chiefly in the nervous tissue and has a greater affinity for that than it has for antitoxin which remains chiefly in the blood. By the time that the preliminary convulsions appear, the toxins have united firmly with the central system and it is impossible to dislodge it with antitoxin. However, large doses of the serum should be given—30, 40, 50 c.c. up to even 100 c.c. in a dose, and at the same time narcotics and local treatment should not be omitted. Of late, anti-tetanic serum has been given intracerebrally by boring a hole in the skull and passing the needle of the syringe into the lateral ventricle of the brain. The fluid must be injected very slowly and small quantities must be used. The idea is that the serum will bathe that part of the brain which contains the nerve centres which control the main functions of the body.

As a prophylactic, anti-tetanic serum is of great value and should be injected where wounds have been contaminated with soil in districts where tetanus abounds.

Anti-venene.—This is an antitoxic serum and is the antidote to snake poisons. It is prepared by injecting horses with two varieties of snake poison, that from the Colubridæ or Cobra species and from the Viperidæ or Viper species. The poisons of these two classes vary in their action, the former attacking nerve tissue and the latter, the blood. These two poisons are injected into horses and the resultant serum is protective against both varieties of snakes. The inoculation must be carried out with very great care as horses are easily killed by excessive doses. It takes a long—up to a year and a half—to get the maximum immunity out of a horse, and at the end of that time the animal is bled in the usual way and the serum obtained. In cases of snake bites, the serum should be administered as soon as possible in large doses and should be injected into a vein. About 30 to 40 c.c. should be given and in this way a certain amount of poison may be neutralised, thereby reducing it to a non-lethal dose. This serum has given good results, but the great difficulty is to be able to inject it soon enough.

These three sera are the chief antitoxic sera and it now remains to consider the chief anti-bacterial sera.

Anti-streptococcus serum.—This is prepared from various strains of the strepcoccus and is obtained by injecting a mixture of these strains into a horse and obtaining the serum. These strains are obtained from a variety of septic conditions, such as puerperal fever, erysipelas, cellulitis, septicæmia, and scarlet fever. There is a special serum obtained from the strains found in puerperal fever alone, but its value is doubtful. The polyvalent serum prepared from other septic conditions has given discordant results. Several cases, however, have been reported where good results have undoubtedly been obtained.

Anti-typhoid serum.—The value of this serum, as a curative agent, has not yet been established. It is, indeed, doubtful whether any benefits obtained are due to the serum or to the excess of toxin which is injected into the animal. Wright considers it to be a vaccine in disguise.

Anti-meningococcus serum.—This is obtained by treating horses with the organism of cerebro-spinal meningitis. It is given in large doses during the acute stage of the disease and some good results have been recorded. The serum seems to be most efficient when injected into the spinal canal by lumbar puncture.

This now finishes a short account of the more common antitoxic and antibacterial sera. It would, however, be incomplete unless some mention were made of serum eruptions and anaphylaxis. After the administration of a serum, in a few cases symptoms are produced such as rash and fever. These soon pass off. It seems to be due partly to the idiosyncrasy of the patient. These symptoms do not occur so frequently if the bulk of fluid injected is lessened. Occasionally, when a second dose of serum is given some days after, serious symptoms may be produced and may lead to the death of the patient. This condition of supersensitiveness is known as anaphylaxis, and fortunately does not occur frequently. It is not my intention to discuss the condition as it is still the subject of much experiment and its cause is still under debate. It seems that purification of the serum from toxic substances is tending to obviate this untoward condition.

No work is worth doing badly, and he who puts his best into every task will outstrip the man who waits for a great opportunity.—*Joseph Chamberlain.*

Work is our business; its success is God's.—*German Proverb.*