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This Bulletin is issued to every unit of the Canadian Army Medical Corps. It will be passed for reading, and will be initialled by all Officers. After return it will be kept on file by the Officer Commanding for further reference.

THE TRANSPLANTATION OF BONE REPAIR OF CRANIAL DEFECTS

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Loss of substance in a skull bone was so rare, previous to this War, that it was seen only occasionally where trephining had been performed for fracture of the skull or decompression for intracranial lesion. During the past three and a half years the number of cases suffering from cranial defects has been rapidly increasing, probably resulting from the modern system of trench fighting. The injuries to the skull have, like wounds received in other parts of the body, been practically always infected, often being complicated by a foreign body lodging in the meninges or brain substance. This condition has necessitated free removal of bone either at the casualty clearing station or base hospital, according to the methods of Sargeant [1] or Cushing [2], and the patient arrives in England with a wound which is usually healed completely or may have a small discharging sinus.

This hospital receives cases directly from France and also transfers of Canadians from Imperial hospitals. On January 1, 1918, the surgical service of this hospital had under treatment 1,317 cases, of which 1,031 had been admitted in convoys from France, the remainder having been transferred from hospitals in England. From examination of the 1,317 cases, twenty-eight were found to be suffering from cranial defects. Of these twenty-eight cases, sixteen had been admitted in convoys from France, and twelve had been transferred from Imperial hospitals in England. From these figures it will be seen that the average of cranial defects admitted to this hospital is over 2 per cent. of the total surgical casualties.

This report is based upon twenty cases in which we performed a bone-grafting operation for the repair of cranial defects. The practical use of bone graft has been a subject of much study to surgeons for more than a century. Professor Arthur Keith [3] has recently pointed out to us that John Hunter was one of the pioneers in bone grafting and fully realized its usefulness and value, but failed to carry it to a successful issue on account of sepsis. In 1867 Ollier, of Lyons, published an important work in which he proved that transplanted compact bone could live without its periosteum. Recently (1917) Major Hey Groves [4] has published a review of the work performed by Ollier, Barth, Axhausen, and Macewen during the past three decades, and in the same article published the results of his own experiments with the grafting of bone in cats. From a careful analysis of their work it is found that they all agree on several main points.

(1) That compact bone can live and proliferate when transplanted.

(2) That periosteum does not reproduce bone.

(3) That the viability of the graft is increased if both periosteum and endosteum have been retained.

In 1914 Gallie [5], of Toronto, published a report of a series of interesting experiments. The conclusion he arrived at, as a result of these experiments, was that grafted bone dies, but at the same time acts as a scaffold which becomes vascularized, and which is invaded by osteogenetic cells from the host. From these invading cells new bone is produced. That grafted bone does not die, as Gallie believed, has been proven in a case reported by Sir Robert Jones [6], in which he had transplanted a long strip of tibia from the sound limb into the epiphyseal ends of a tibia whose shaft had been removed for osteomyelitis. The graft united to the host and grew rapidly, according to Wolff's law, and the case was discharged from the hospital. Six months from the time of the grafting operation the patient was knocked down by a bus and the grafted bone fractured in the centre. The

care of Sir Robert Jones, who had a series of skiagrams taken during the recovery. These pictures show callus forming at the point of fracture, and firm union resulted within the average time allowed for normal bone. Albee [7] has reported a large number of cases in which he has performed his sliding graft operation in simple fractures of the long bones. Skiagrams taken later show firm union between the grafts and the hosts. Sir William Macewen [8] reports a case in which he removed a large piece of a parietal bone when operating for the relief of cystic intracranial disease. The bone was preserved in warm saline solution for half an hour and then re-implanted. Five years later the patient died from a pulmonary condition, and on reflecting the scalp it was found that firm osseous union had occurred between the re-implanted bone and the skull.

McWilliams [9] in his review concludes that the survival of a graft depends on the establishment of a sufficient blood supply, and that blood supply is more quickly and efficiently established when both periosteum and endosteum are transplanted. Of the different theories advanced on the growth of bone, it is now generally conceded that the one taught by Sir William Macewen is the most definite. Macewen proved in his experiments that periosteum does not reproduce bone, but merely acts as a limiting membrane, and that new bone is formed by the proliferation of osteoblasts within the grafted bone itself and quite independent of the periosteum.

As a result of the conclusions of these investigators we believed that a very extensive field had opened in which bone could be used in the repair of cranial defects. It will be seen by the statistics of this hospital alone that the number of cases in which there has been a loss of bone substance will average fairly high in the total casualties. It is realized that a cranial defect usually makes a man unfit for any active occupation, and, indeed, judging from the marked degree of depression, suffering, and fear seen in many of these cases, they will become wards of the State during their lifetime. Realizing this, we have endeavoured to develop a form of treatment which will help these men to become an economic part of the man power of the nation and not mere helpless dependents.

To ensure a successful result in our transplanting of bone we found there were several fundamental principles to be carried out in all cases.

(1) No graft should be attempted until all discharge has ceased and the wound has been perfectly healed for three months. This time differs from the period we wait after the healing in long bones. In compound fractures of the long bones we insist that the wound must be healed for at least six months before operating. However, we have found that operations on the skull can be performed after a waiting period of three months without fear of stirring up a latent infection. The great vascularity of the scalp is probably responsible for this difference.

(2) Most careful aseptic technique both in preparation of patient and during operation.

(3) The graft should be autogenous, the crest and inner surface of the tibia being most suitable.

(4) The periosteum of both the host and grafted bones should be retained, as well as some of the endosteum, in the graft.

(5) Close apposition and immobilization of graft into host.

(6) Small drainage tube in one corner of the wound for twenty-four hours to allow drainage for the slight oozing which it is impossible to control in the flap.

In studying the case sheets of this series it is found that consciousness is lost at the time of injury in a large percentage of cases, and is not regained for some hours at least, and, indeed, often for several days. The notes on the field medical card accompanying the man, although brief, usually give most valuable and interesting data: it is from these we learn the extent of injury and the form and type of treatment carried out. When these cases are evacuated to England some weeks have elapsed, and they are convalescent from their first operation.

On examination of the head a loss of bone substance is found, usually showing a definite depression which markedly pulsates. The scar and area around the depression are sensitive and painful to touch. On interrogation, the patient's cerebration is found to be slow and the memory poor. A constant symptom is an extreme degree of depres-

¹ [Reference should be made to the full and careful studies of Berg and Thalheimer (*Annals of Surgery*, 1918, 67, 331), published since this article was completed. In it Macewen's doctrine is apparently successfully confuted; but while it is shown that periosteum transplanted can develop bone, it is also demonstrated, in harmony with the views here put forward, that the endosteum and osteoblasts lining Haversian canals in autogenous bone transplants produce bone actively. —Ed.]

sion, often associated with fear, the fear being probably due to an apprehension of further injury to the pulsating cavity. The patient appears drowsy and lacks initiative. Severe headache is present in all cases. The headache is usually aggravated by movement. The headaches may be intermittent or of a continuous character, but even in the intermittent type the man is never free from pain for more than a few hours. The constant headache is no doubt due to the dura mater (which is almost entirely supplied by the fifth cranial nerve), being firmly adherent to the old scar tissue, and so under constant irritation. Motor aphasia was present in three of the twenty cases, and epileptiform seizures occurred in three cases. Vomiting may occur, especially during exercise, and after vomiting dizziness is marked. In all cases there were very definite and constant eye symptoms. In every case there was an abnormal contracting of the colour fields, sometimes being irregular and interlacing, at other times being entirely absent, resulting in a complete colour blindness. Blurring of vision with a slight choked disc was common. Partial hemiplegia or monoplegia, exaggerated reflexes, areas of anaesthesia, and a marked abhorrence of noise have been found.

Technique of Operation.—Forty-eight hours before operation the head is shaved, great care being taken to avoid nicking the skin, especially in the vicinity of the old scar. The head is well washed with green soap and water, followed by ether and alcohol and a dry sterile dressing and cap applied. Twenty-four hours preceding operation the head, forehead, and ears are freely painted with tr. iodine, allowed to dry, and a dry sterile dressing is again applied.

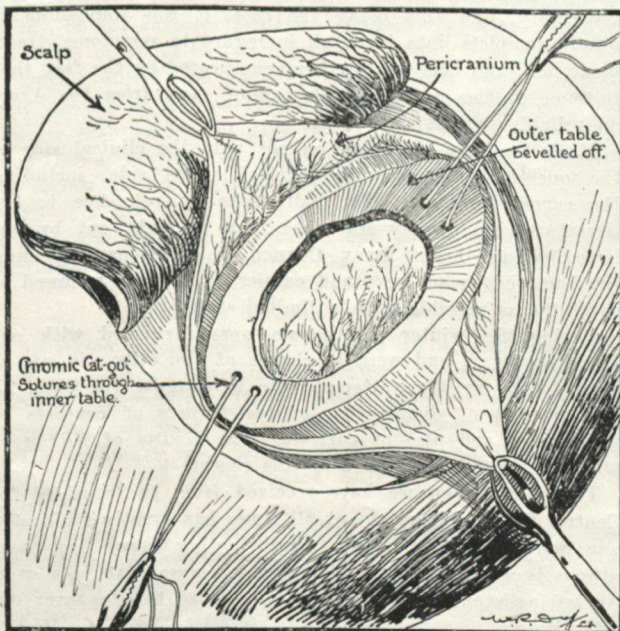
The anaesthetic is of the greatest importance, not only for the safety of the patient, but also that it may be administered in such a way that the anaesthetist will not obstruct the operator. In our first seven cases rectal anaesthesia was used as follows: Two hours before operation the rectum was repeatedly washed until all fluid returned clear. One hour preceding morphine gr. $\frac{1}{4}$ with scopolamine gr. $\frac{1}{100}$ was given hypodermically. To induce anaesthesia 4 oz. of ether was well shaken with 2 oz. of olive oil, and this was slowly introduced into the rectum, at least ten minutes being taken. Surgical anaesthesia was present in thirty to forty minutes. While the anaesthesia produced was all that could be desired, we decided after two unpleasant experiences resulting from shock occurring during the deep anaesthesia that a form of anaesthesia in which the patient could be permitted to "come out" quickly would be safer. Since then we have used an intratracheal method which is most satisfactory in all respects.

supply to the pericranium, which will form the covering and part of the blood supply to the graft. After reflecting the skin flap a longitudinal incision is made through the occipitofrontalis aponeurosis and pericranium over the skull opening, extending to at least $1\frac{1}{2}$ in. to either side of the opening. At the site of the old scar it will be found that the aponeurosis, pericranium, and dura mater are all matted together in a dense mass of cicatricial tissue. With care this scar tissue can be stripped from the dura mater, provided that this membrane has not been opened at the time of injury or first operation. The dura mater, which is found firmly adherent to the edges of the opening in the bone, is then freed, and a periosteal elevator passed under the bony margin to see there are no adhesions here. If the dura mater has been opened at the time of injury or at the previous operation, it will be found to be so densely involved in the scar as to make it impossible to separate without opening. If it is found necessary to open the dura mater it is done by making a cross incision, freeing the adhesions to the cortex and turning back the corners. This opening in the dura mater is closed by grafting a small piece of fascia lata with some fat adherent to its surface. The surface containing the fat is placed against the cortex, and the fascia lata tacked to the dura mater at the corners by four fine catgut sutures.

The bed for the graft is now made by bevelling off the outer table for a distance of $\frac{1}{2}$ in. from the bony opening. To do this a Martel burr is attached to an Albee motor, and the outer table is carefully removed, in such a way that the cancellous and vascular diploë, from which the skull receives its main blood supply, is left to act as a fertile bed to receive the graft. Two or three holes are now drilled through the inner table with Albee's electric drill, a metal guard being placed between the inner table and dura mater to prevent injury to the brain. Twenty-day chromic catgut is threaded through these holes to be used in immobilizing the graft. The head is now covered with warm sterile towels and left, while the graft from the tibia is removed.

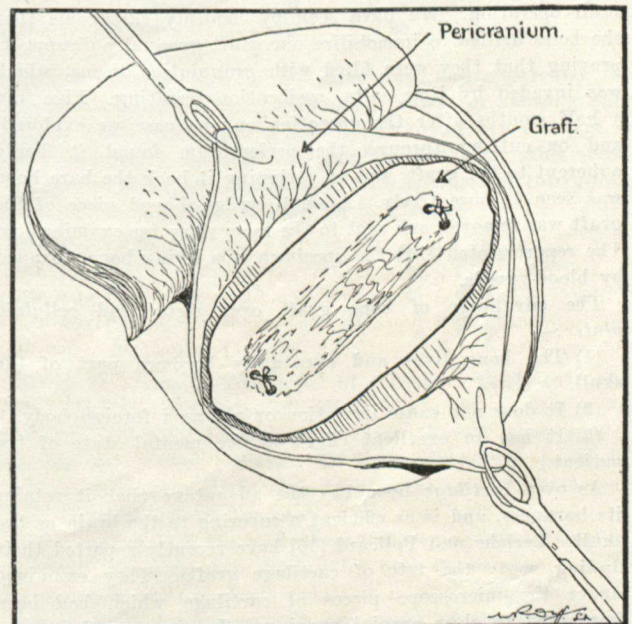
To remove the tibial graft the bone is exposed for at least 8 in., a flap being preferable. The inner surface of the tibia gives the best area. A graft, the entire width of this surface and $\frac{1}{8}$ in. in thickness and retaining its periosteum, is removed by using a saw, the blade of which is narrow and can be turned to any angle.

On removal the graft is immediately transferred to its bed in the skull. The graft is never placed in saline or other media, as any foreign substance tends to devitalize the graft. The periosteal surface of the graft is turned towards the



Outer table bevelled off, diploë and inner table showing.

To expose our cranial opening the horseshoe flap is used, making the incision at least $1\frac{1}{2}$ in. from the edge of the bony opening. In bringing down this flap one of the most important points in the whole operation occurs. The primary incision must be made only through the skin and subcutaneous layer and the flap thrown back, leaving the occipitofrontalis aponeurosis (galea aponeurotica) attached to the pericranium. This gives strength and an increase of blood



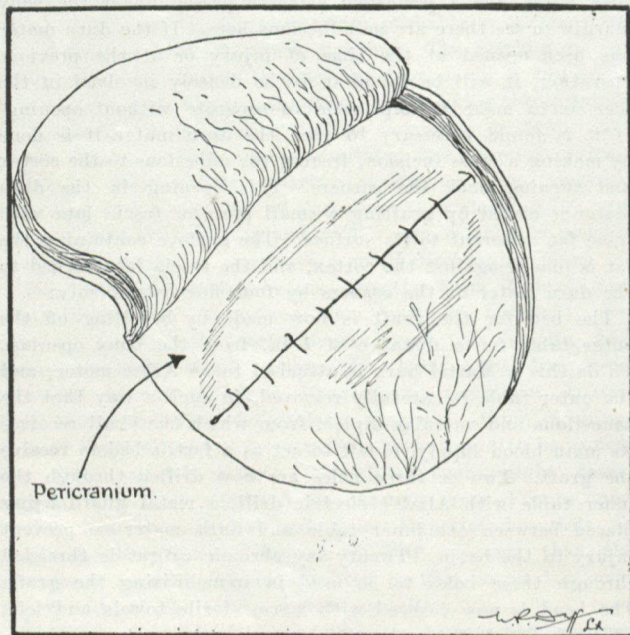
Bone graft immobilized.

dura mater, only the area which will lie on the diploë being bared of periosteum. The periosteum is turned towards the dura mater for three reasons:—

- (1) To provide a smooth surface with which the dura mater shall be in contact.
- (2) To guard against growth of bone inwards. The periosteum being a limiting membrane prevents any chance of an exostosis growing from the under surface of the graft and eventually causing pressure.

(3) The endosteal surface of the graft will be covered by pericranium.

When the graft has been carefully immobilized by tying the chromic catgut which has been threaded through holes drilled in the ends of the bone, the reflected pericranium and occipito-frontalis aponeurosis is carefully sutured over the graft, every endeavour being made to cover its entire surface. The scalp flap is now brought over and sutured with interrupted silkworm-gut sutures, a small drainage tube being left in one corner for twenty-four hours. Plenty of dressings are applied along with a firm head bandage or cap, which will give a fair amount of pressure over the operative area.



Occipito-frontalis aponeurosis and pericranium have been sutured over graft.

Some doubt may be expressed as to the probability of these grafts living. Macewen implanted nude bone shavings into muscle and peritoneum; in both cases they survived, one graft actually increasing in size. It has previously been pointed out that the grafts in long bones live, and, as there is absolutely no difference between the osteoblasts of the skull and those of the long bones, it follows that we have no reason to doubt that successful results should follow the skull operation. We have seen by monthly skiagrams that the holes drilled to immobilize our graft gradually disappear, proving that they were filled with granulation tissue, which was invaded by lime salts, ossification resulting. Five and a half months after the operation on one case we explored, and on cutting through the pericranium found it firmly adherent to the graft, and on stripping it back the bare bone was seen to ooze freely. A small wedge-shaped piece of the graft was removed and sent to the laboratory for examination. The report stated that the specimen was living bone, invaded by blood-vessels.

The advantage of bone graft over *metal* and *celluloid* plates:—

- (1) The bone lives and eventually becomes part of the skull.
- (2) It does not cause irritation or act as a foreign body.
- (3) It has an excellent effect on the mental state of the patient.

As over *cartilage* bone has the advantage that it retains its hardness, and is as efficient a covering to the brain as the skull. Leriche and Policard [10] have recently reported their finding as to the fate of cartilage grafts. They examined under the microscope pieces of cartilage which had been implanted to close cranial openings. In one case the operation had taken place thirty-six days previously, and in the other one year had elapsed. In both cases it was seen that the cartilage proper had been substituted by connective tissue. We found in two cases in which we used cartilage that after five months the graft softened, and did not give the same amount of protection as did bone.

In conclusion, we would draw special attention to the following benefits resulting from operative procedure:—

- (1) The depression passes off, and the patient becomes optimistic and bright.

(2) Headaches have improved in all cases; in a large percentage they have disappeared entirely.

(3) The memory improves and dizziness disappears.

(4) The eyesight improves, the blurring of vision disappears, and the colour fields increase.

(5) The man is elevated from being a permanent ward of the State to a useful citizen, capable of carrying on any ordinary occupation.

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CEREBROSPINAL FEVER.

Report on Investigations made by No. 1 Canadian General Laboratory, Folkestone, during 1916 and 1917.

By F. B. BOWMAN, M.B.Tor., Major, C.A.M.C., late O.C. Laboratory; F. ADAMS, M.B., D.P.H.Tor., Captain, C.A.M.C.; and R. N. JANES, M.B.Tor., Captain, C.A.M.C.

(Extracted from Report made to War Office.)

THE report will be made under the following headings:—

- (1) General Considerations.
- (2) Bacteriology, Cultural Characteristics of the Meningococcus, &c.
- (3) Notes on Agglutination Tests.
- (4) The Carrier Problem—the Levick Sprayer.
- (5) Notes on Cases.
- (6) Conclusions.

(1) GENERAL CONSIDERATIONS.

During 1916 and 1917 in this unit certain plans were made for the study of cerebrospinal fever, and different problems were given to different officers on the staff to investigate. It might be noted that all cases of cerebrospinal fever in the Shorncliffe district and Dover Garrison, as well as the Shorncliffe area, come within the radius served by this laboratory, and this being the case, it was impossible to obtain complete data in detail in regard to symptoms, treatment, &c., and this was further complicated by the fact that in some of the civil hospitals taking cases from the Army no reliable records were kept.

Much has been published on not only the clinical side of the question, but also the bacteriological side, including the carrier problem. We shall make no reference to the literature, but simply state the facts brought out by our investigations here. Army Council Instructions regarding the bacteriology of cases and carriers have been followed as carefully as possible with a limited staff.

During the winter months we were furnished with one Levick sprayer, and were in charge of two others in use at Dover, and we have attempted to investigate the value of this method of disinfection of the throats of contacts of meningitis, and also of carriers. The results of this work will be shown in Section 5 of this report.

The co-operation we have received from the Staff of the Central C.S.F. Laboratory at all times has greatly facilitated our work. Culture media, agglutinating sera, &c., have always been received promptly, and when we have been over-worked assistants have been sent to us to help us over our difficulties.

(2) BACTERIOLOGY.

In our work only legumin trypt-agar, the culture medium supplied by the Central C.S.F. Laboratory, has been used. When properly made it would seem to be the best culture medium for routine use at the present time. We attempted to prepare it ourselves, but found that the difficulties presented by accurate titration, &c., were too deep for the limited staff in our media room. This medium is very clear, while nearly all others recommended for the meningococcus

are more or less opaque. The colonies can be easily studied, and suspicious ones recognized and fished off.

During the past year all of our plate cultures have been made at the time of taking the naso-pharyngeal swab. They are then placed in a portable incubator and transmitted to the laboratory, and placed in the incubator there for at least eighteen hours. We have found that a dry plate is much better than a moist one, and to obtain this, before the plates are sterilized, a circle of blotting paper is placed in the lid, and after pouring they are put in the incubator at 37 degrees overnight, and in this way any surface moisture disappears, and any bacterial contamination is shown. This is a very important point. On several occasions a day's work has been ruined by "spreaders" overgrowing the plates after the cultures have been made. By incubating them first this difficulty has been eliminated.

We have found that small plates with one culture on a single plate are preferable to larger plates with one or two cultures on each.

When the naso-pharyngeal culture has been taken the swab is pulled out of the opposite end of the tube, and touched lightly at several places on the media toward one side of the plate. Then, instead of the small curved wires recommended by the Central C.S.F. Laboratory for spreading the culture, we use sterile wooden applicators with a little cotton wound around the end, and find that in using these there is little chance of breaking the medium and better plates are made.

It has been stated, and was stated by one of us last year in a report made to the War Office, that about 80 per cent. of positive colonies can be recognized morphologically. We decided to test this practically. Fifty-seven plate cultures were examined, and notes on the following characteristics were made: colour, size, and consistency, macroscopically; and microscopically, whether they were coarsely or finely granular, pigmented, and had a smooth or a serrated margin. Agglutinations were then done to prove or disprove our conclusions. The meningococcus colonies are usually described as being unpigmented, or very slightly so, of medium size, easily emulsified, and microscopically appear finely granular and pale, with a clear-cut margin. In a general way this is true, but colonies approaching this description in any way should be transplanted and agglutinated. Chart I will give some idea of the possibilities of being led astray by relying too much on morphological characteristics. Up to 1st June 121 specimens of cerebrospinal fluid were examined and plated. Of these seventy-eight were positive. It would seem at first glance that this is rather a low percentage, but only twenty-one of these were negative on the first examination. Thus, of 121 cultures made on legumin tryptic agar, 100 were positive, or about 83 per cent.

During 1916-17 we gave up entirely both sugar reactions and growth at 23° in identifying the meningococcus. The former requires several days before any reaction takes place, and then it may be inconclusive, and we had great difficulty in maintaining a regular temperature at 23° C.

To sum up, the cultural characteristics of the meningococcus are generally the same, but one must rely on the agglutination test to identify the organisms definitely.

(3) NOTES ON AGGLUTINATION TESTS.

As stated before, we have obtained all agglutinating sera and homologous suspensions of meningococci from the Central C.S.F. Laboratory. These have always been received promptly, and have usually been satisfactory.

The technique outlined by Gordon and Hine in the performance of the agglutination tests has been followed in principle.

On going over several hundred agglutination tests done during the past year, we found that all positive agglutination tests were positive at 1-100 dilution, and all negatives were negative at this dilution. We decided, therefore, to use only one tube for each type containing one dilution of serum (1-100). This plan was only varied when the agglutinating serum was of very high titre, and then the dilution was increased to 1-200, not, however, for accuracy in results, but to save agglutinating serum.

Having only one incubator working at 55°, we decided to compare results of incubating a 1-100 dilution for eighteen hours with an incubation of 1-200 dilution for twenty-four hours. The results obtained were practically identical, and the former method was followed throughout.

During the period from November, 1916, to June, 1917, inclusive, 1,133 agglutination tests were done, and 534 were found positive. Thus, of 1,133 cultures called suspicious, about 47 per cent. only were positive agglutinatively, and were divided as follows:—

Type I	...	...	...	183 or 34.2 per cent.
Type II	...	...	...	292 or 54.6 "
Type III	...	...	...	20 or 3.7 "
Type IV	...	...	...	39 or 7.3 "

These results would appear to agree with those of other observers in England. Our results also show that the type of organism found among Canadian troops does not vary from that found among English troops, although in 1915 one of us isolated one of the first Type IV organisms, which was definitely identified as such from a Canadian soldier.

No absorption tests were done on organisms exhibiting agglutination with two sera; these were always forwarded to the Central C.S.F. Laboratory for further investigation.

(4) THE CARRIER PROBLEM.

Since 1915 the many problems concerning carriers have been investigated from many standpoints by different observers. The labour connected with the preparation of culture media, swabs, and agglutinating sera has been taken into consideration, to say nothing of the isolation of hundreds of men from their daily training and duties wherever they may be.

Army Council Instructions have been followed carefully in this laboratory, and certain statistics obtained would seem to be of interest. All men proceeding to London for duty there from the Shorncliffe area must be swabbed, and proved negative for meningococci before being allowed to leave.

Between November 11, 1916, and April 5, 1917, 661 men were swabbed, and sixty were found positive, or 9.1 per cent., and the types were as follows:—

Type I	...	...	...	16 or 2.4 per cent.
Type II	...	...	...	35 or 5.3 "
Type III	...	...	...	6 or 0.9 "
Type IV	...	...	...	3 or 0.45 "

It is interesting to note that from November to April the percentage gradually increased, and is shown in the following table:—

From No.	1 to No.	55	...	2 or 3.6 per cent.
"	55	"	155	3 " 3.0 "
"	155	"	255	6 " 6.0 "
"	255	"	355	5 " 5.0 "
"	355	"	455	5 " 5.0 "
"	455	"	555	14 " 15.0 "
"	555	"	661	25 " 23.6 "

These were all done in the same way, and apparently the seasonal influence is well illustrated, November showing only 3.6 per cent., while March and April showed 23.6 per cent.

In contrast to the above figures, the following table showing the result of the swabbing of 1,151 contacts of thirty-four cases of cerebrospinal meningitis is given:—

Total positive	...	...	...	71 or 6.17 per cent.
Type I	...	...	...	20 " 1.73 "
" II	...	...	...	44 " 3.82 "
" III	...	...	...	1 " 0.807 "
" IV	...	...	...	6 " 0.52 "

From only twenty-seven cases of the above thirty-four was the organism definitely identified as to type, and 1,000 contacts of these twenty-seven cases showed that 63, or 6.3 per cent., were positive. Of these sixty-three positives, only nineteen were of the same type as the case of which they were contacts, or 1.9 per cent.

Thus we see that the percentages of meningococcus carriers in these instances were higher by over 2 per cent. among non-contacts than contacts, while it is also remarkable that such a small percentage (1.9 per cent.) of the contacts of the cases agreed with the type found in the case.

During March and April of 1917 an epidemic of cerebrospinal fever occurred in the 31st Training Reserve Battalion. Several interesting points were taken up in connection with this epidemic, which will be treated in some detail.

The battalion was about 2,300 strong, and, with the exception of officers and non-commissioned officers, was made up entirely of boys under 19 years of age.

The men were well housed generally, some in huts, some in billets, and a few in tents. The conditions under which

they lived were at least average. During February a draft of about 600 men came to the battalion from Southend. Later we learned that there had been cases of cerebrospinal fever occurring among the troops there. About the middle of March the first case of cerebrospinal fever occurred in this battalion, and by April 1 eight genuine cases and three suspected cases had appeared. The suspicious cases afterwards proved to be negative.

As these cases were scattered it was decided to place the entire battalion in quarantine, and make a general survey of the camp to learn, if possible, the carrier rate. The first fifteen men in A Company, C Company, and F Company, as well as fifteen contacts of Pocock, a case, and fifteen contacts of Ticker, a case, were swabbed. The reason for swabbing the contacts of the cases, as well as the others, was to draw a comparison between the percentage of carriers among the contacts and non-contacts. The first swabbing indicated that at least 25 per cent. of the whole battalion were carriers, and that there was little difference between contacts and non-contacts; quarantine of the battalion was, therefore, maintained; Levick steam atomizers were obtained, and a special hut was selected and partitioned off into three rooms of 1,000 cubic feet each. A non-commissioned officer was trained in the use of the sprayer and put in charge, and the whole battalion was passed through the spray rooms daily. At least two of the sprayers were working continuously, and the men were only marched in when the room was quite foggy. A solution of chloramine-T has been used in the apparatus throughout.

The forty-five non-contacts before mentioned, as well as the thirty contacts, were put through the same as the rest of the men, and in the proper order. They have continued their training with their respective platoon, and have not been treated in any way differently from the other men. They were only collected *together* occasionally for swabbing purposes. At the time of writing one month has elapsed, and the whole battalion has been through the sprayer every day during this time. The forty-five non-contacts and the thirty contacts were swabbed at intervals. It might be asked why the same men were chosen for swabbing each day. As they were not selected, but taken at random in the first instance, it was considered unnecessary to examine other men and thus complicate the work.

The first swabbing showed 26.6 per cent. positive; the second swabbing, five days later, 20 per cent.; the third swabbing, fifteen days later, 21.3 per cent.; and the fourth swabbing, seven days later, 42.6 per cent. positive. Of those found positive on the fourth swabbing, thirteen were positive for the first time, and included types I, II, and III.

At some time during the investigation 72 per cent. of the seventy-five men were found positive, and only 28 per cent. were negative throughout, and seven cases changed type. The use of the atomizer apparently had no effect in reducing the number of carriers examined.

During the month, while the men were passing through the spray chamber, an epidemic of measles broke out, and seemed to be uninfluenced by the treatment. It may be noted that after April 6 no new cases of cerebrospinal fever developed, and this was only three days after the use of the atomizer was begun. From the naso-pharyngeal cultures one might be forced to conclude that the sprayer was of little use, but the non-appearance of clinical cases would seem to contradict this. The question of the susceptibility of certain individuals arises. In this battalion of 2,300 young, healthy men the infection was widespread, and thirteen cases developed altogether, therefore one might be allowed to suppose that 0.6 per cent. were susceptible.

It is well known that carriers outnumber cases many times, and it might be stated that invasion of the meninges is *very, very rare* by a *comparatively common* organism present in the naso-pharynx, i.e., the meningococcus.

While this battalion was under observation fifty-four carriers were found among seventy-five men taken at random, therefore in the whole battalion there may have been 1,656 carriers, or 127 carriers to each clinical case. Can it be stated that the infection would have had to pass through 127 individuals before reaching one who was susceptible?

Ordinarily the contacts of a soldier number about thirty or thirty-five (the men quartered in an ordinary hut), therefore swabbing as ordinarily practised would seem to miss a great many of the carriers in a unit. These observations and calculations are based only on our experience in the 31st

Training Reserve Battalion, and are only suggested as possible answers to some of the many questions related to the carrier problem.

NOTES ON CASES.

As stated before these will be rather meagre, and although in 1917 thirty-four cases of meningitis occurred, of which this unit had charge, in only twenty-three were we able to secure histories worth recording. The cases when seen by us were examined clinically, cerebrospinal fluid withdrawn and serum injected, following out the rules as set forth in the "Memorandum on Cerebrospinal Fever among Troops" (24/Gen.—No./3595 (A.M.D.2)).

Some of the cases are still under observation at the time of writing, and definite conclusions as to the ultimate result cannot be drawn.

A chart showing the main clinical features of twenty-five cases is attached. As regards the virulence of different types of meningococci, there seems to be little relation between this and the types. On glancing through the histories of these cases it will be seen that all types occurred, both in those which recovered and those which were fatal.

As to treatment. The draining of the cerebrospinal fluid regularly and the injection of a satisfactory serum would seem to be the best. However, it will be seen from these histories that several cases recovered under treatment in the acute stage which theoretically cannot be explained, treatment which probably had little to do with the recovery. It is certain that all cases of meningitis should be constantly under close observation by a competent medical officer; one who has had experience in the treatment of this disease.

One or two cases may be mentioned particularly as being unusual.

Case No. 6.—Gram-negative organisms in considerable numbers was found in the urine and reported by the pathologist at this hospital. No significance was attached to this observation, however, and cultures were not preserved or agglutinated. The patient later developed cerebrospinal fever, and it would seem that the nephritic condition was possibly due to the meningococcus.

Case No. 8.—A child with specific cerebrospinal fever and tuberculous meningitis combined. The meningococci disappeared from the cerebrospinal fluid, and the child died of the tuberculous condition.

Case No. 20.—Is unique because of the absence of the usual signs. He was only admitted to the hospital twenty-four hours before he died, and then the only symptom was a slight purpuric rash. He had never had any neck rigidity or Kernig's sign.

Case No. 18.—This man recovered completely, and suddenly relapsed and died of meningitis two weeks later.

BRIEF CLINICAL RECORDS FROM CEREBROSPINAL FEVER CASES.

These brief histories were abstracted from notes made at the hospitals where the cases were under treatment, and all came under the laboratory for bacteriological investigation. They were selected as being of interest.

Case No. 1.—Pte. E., aged 18.

Was admitted on March 8, 1917. Symptoms had begun six days previous to this on March 2, 1917. His temperature on admission was 102° F., and pulse-rate 76.

Symptoms were as follows:—

Headache, photophobia, pains in lumbar region, vomiting, herpes vulgaris, opisthotonos. Kernig's, Brujinski's, and Babinski's signs were present. Pupils were equal, but reacted sluggishly to light. For the first four days of his illness he was unconscious at times.

Spinal fluid was turbid, and a Gram-negative diplococcus was obtained from it. Culture showed type II meningococcus.

Treatment.—Seven lumbar punctures in all were done, 25 c.c. of anti-meningococcic serum being administered each time. Chloral and bromides were administered for sleeplessness when necessary.

During convalescence the patient complained of quite marked lumbar and precordial pain.

Patient was discharged quite well on May 18, 1917, i.e., after a stay in hospital of seventy-one days.

Case No. 2.—Pte. G., aged 24.

Was admitted on March 15, 1917. Symptoms began on March 13, 1917, i.e., two days previous. Temperature on admission was 103° F., and pulse-rate 96.

Symptoms were as follows:—

Headache, photophobia, pain in lumbar region, vomiting, opisthotonos. Kernig's and Brujinski's signs were present. Babinski's sign was absent; reflexes were exaggerated. Pupils equal, but reacted slowly. Was diagnosed on presence of Gram-negative diplococcus in stained smear from spinal fluid. Type of organism unknown, as culture was never obtained.

Treatment.—Eleven lumbar punctures were done, and from 25 to 30 c.c. of anti-meningococcic serum administered each time. He was given at one time 20 c.c. of serum from Pte. M. (another case), and at another 10 c.c. of inactivated spinal fluid obtained from him, and inactivated at 56° C. for one hour. Pituitrin and caffeine are now being administered.

The acute stage is now over, but patient is unable to retain food. Vomiting does not seem to follow the taking of food, but seems to be reflex. Has recrudescences in which there are headaches and stiffness of neck. These periods are becoming gradually farther apart and of shorter duration. He still has periods in which he is delirious. Patient is very emaciated. (Note made June 11, 1917.)

Case No. 3.—Pte. P., aged 20.

Was admitted March 9, 1917. Symptoms began on March 5, 1917, four days previous to this. Temperature on admission 103.4° F., and pulse-rate 110.

Symptoms were as follows:—

Headache, photophobia, pain in lumbar region, vomiting, herpes simplex, and opisthotonos. Kernig's, Brujinski's, and Babinski's signs present. Pupils equal; some nystagmus. Organism type I; meningococcus obtained from spinal fluid.

Treatment.—Lumbar puncture was done, and 25 c.c. anti-meningococci serum administered each day for six days. Chloral and bromides were given when necessary for sleeplessness.

Patient was discharged quite well with no after-effects on May 15, 1917, after a stay of sixty-five days in hospital.

Case No. 4.—Pte. G., aged 29.

Was admitted on March 14, 1917. Symptoms began March 12, 1917, two days previously. Temperature on admission 104° F., and pulse-rate 130.

Symptoms were as follows:—

Headache, photophobia, pain in lumbar region, vomiting, herpes, and opisthotonos. He was unconscious during periods of the first four days in hospital. Pupils equal; lateral nystagmus. Kernig's, Brujinski's, and Babinski's signs were present. Organism type I meningococcus obtained from nasal swab late in disease.

Treatment.—Lumbar puncture daily for first four days, and 25 c.c. of anti-meningococcic serum administered each time. Chloral and bromides were given when necessary for restlessness.

A negative throat swab was obtained on April 20, 1917. Patient discharged to convalescent home on May 3, 1917, after a stay in hospital of fifty days, having made a good recovery.

Case No. 5.—Pte. R., aged 27.

Was admitted on March 14, 1917. Symptoms began on March 12, 1917, two days previously. Temperature on admission was 103.6° F., and pulse-rate 135.

Symptoms were as follows:—

Headache, photophobia, pain in lumbar region, vomiting, herpes vulgaris extreme, opisthotonos, pupils equal, squint present. Kernig's, Brujinski's, and Babinski's signs present. Was unconscious at periods during the first three days in hospital.

Organism type II meningococcus obtained from spinal fluid.

Treatment.—Lumbar puncture done, and 25 c.c. anti-meningococcic serum administered daily for five days. Chloral and bromides given when necessary for restlessness.

Patient was very frail for some time, and for days during his convalescence complained of intense lumbar pains. He was transferred to a convalescent home on May 3, 1917, after a stay in hospital of fifty days.

Case No. 6.—Pte. M., aged 23.

Was admitted as a case of acute nephritis. The laboratory reported Gram-negative diplococci in the urine, but no effort was made to establish their identity. Following he developed, about two days later, symptoms of meningitis. A lumbar puncture was done. The spinal fluid was almost clear, but contained a Gram-negative diplococcus, which proved to be type I meningococcus. As the meningeal symptoms appeared the urinary findings rapidly improved. Temperature on admission was 103° F., and pulse-rate 94.

Symptoms were as follows:—

Headache, photophobia, pain in lumbar region, herpes vulgaris. He had no vomiting, and has never lost consciousness. Kernig's, Brujinski's, and Babinski's signs were present. Pupils were equal, and reacted to light.

Anti-meningococcic serum was administered, but how often it is not stated.

Case No. 7.—Pte. T.

Was admitted on April 2, 1917. Symptoms began twelve hours previously. Temperature on admission 102° F., pulse-rate 180.

Patient was delirious when admitted, and unconsciousness came on very rapidly. Pupils were dilated, and lateral nystagmus was present. Kernig's and Brujinski's signs were both present, but neither of them were marked.

Type II meningococcus was obtained from the spinal fluid. Lumbar puncture was done, and 20 c.c. of anti-meningococcic serum was given on admission. A second puncture was done, and 20 c.c. of serum given ten hours after admission. Atropine and adrenalin chloride were given.

Patient died twenty-four hours after admission, after an illness which was said to have lasted only thirty-six hours.

Case No. 8.—Ethel R.

Was admitted February 2, 1917. Symptoms began on previous day. Temperature on admission was 99.2° F., and pulse-rate 108.

Symptoms:—

Headache severe, vomiting, pain in lumbar region, herpes. Was delirious at times. Pupils were markedly dilated, neck rigid. Purpuric rash over the trunk and limbs, around joints, much staining almost like bruises.

Spinal fluid turbid. Type II meningococcus obtained from it.

Treatment.—Lumbar puncture done on first, third, and sixth days in hospital, and from 25 to 30 c.c. anti-meningococcic serum administered. Chloral was given for pain in back and head, which apparently was very severe.

Patient had been under treatment for some years for tuberculous knee, and had been discharged as incurable. She apparently recovered from cerebrospinal fever, but died on April 4 from tuberculous meningitis.

Case No. 9.—Percy C.

Was admitted March 1, 1917. Onset of symptoms was about four days previously. Temperature on admission 101° F., and pulse-rate 94.

Symptoms:—

Excessive head retraction, and neck rigidity alone reported. Type I meningococcus was obtained from the spinal fluid.

Treatment.—Lumbar punctures were done daily for the first four days, but no serum given. On the ninth day developed a rash said to be a serum rash.

Patient made a good recovery, except that from one week after admission he was quite deaf. Was discharged April 4, 1917, after a stay in hospital of thirty-five days.

Case No. 10.—Spr. K., aged 30.

Was admitted February 2, 1917. Onset of symptoms twelve hours before admission. Temperature on admission 103° F., pulse-rate 72.

Symptoms:—

Patient extremely violent on admission, headache, no vomiting, delirious, neck rigid, well-marked purpuric rash, particularly at shoulders and elbows. Organism, type II meningococcus obtained from spinal fluid.

Treatment.—Lumbar punctures done daily, and 30 c.c. anti-meningococcic serum administered each time.

Patient died February 7, 1917, four days after admission.

Case No. 11.—Rudolph B., aged 30.

Admitted April 14, 1917.

Symptoms began April 9, 1917, five days previously. Temperature on admission 98.8° F., and pulse-rate 60.

Symptoms:—

Headache, vomiting, pain in lumbar region, delirious. Kernig's and Brujinski's signs present. Well-marked purpuric rash.

Treatment.—Lumbar punctures done, and 40 c.c. anti-meningococcic serum given the day before admission to hospital. Puncture and administration of 25 c.c. anti-meningococcic serum every other day for four punctures. Anti-meningococcic serum also given subcutaneously in 25 c.c. doses on days when punctures were omitted.

Patient made a good recovery. Was allowed up on May 5, 1917, twenty-four days after admission. At present patient has considerable weakness of the back, otherwise is well.

Case No. 12.—Mrs. F., aged 21.

Was admitted February 22, 1917. Symptoms began twenty-four hours previously. Temperature on admission 101.6° F., pulse-rate 120.

Symptoms:—

Headache, slight pain in lumbar region, vomiting, herpes, semi-conscious on admission. Kernig's sign present. Type I meningococcus obtained from spinal fluid.

Treatment.—Lumbar punctures daily for first five days, and administration of 25 to 30 c.c. anti-meningococcic serum given.

Patient developed a serum rash. Complete recovery made. Discharged on April 3, 1917, after a stay in hospital of forty days.

Case No. 13.—Pte. K.

Was admitted January 25, 1917. The date of onset of symptoms was not known. Temperature on admission was 103.8° F., and pulse-rate 80.

Symptoms were as follows:—

General headache, stiffness of the back and limbs, pupils dilated, left greater than the right, reaction to light, and accommodation normal; nystagmus present. Kernig's and Brujinski's signs present, knee-jerks lessened, plantar reflex absent. A Gram-negative diplococcus was obtained from the spinal fluid, but was not cultivated, therefore the type of organism was not discovered.

Treatment.—Lumbar puncture done on admission, and 25 c.c. anti-meningococcic serum given. Meningococcus vaccine was given every fourth day in doses, increasing from five to fifty millions. Chloral and bromide mixture, and brandy were given as required. No further puncture was done.

Patient made a good recovery after an uneventful convalescence.

Case No. 14.—Pte. S.

Was admitted January 30, 1917. Date of onset of symptoms not known. Temperature on admission 103° F., and pulse-rate 48.

Symptoms were as follows:—

Patient delirious, mouth and throat very foul, marked head retraction, rigidity and stiffness of the legs, pupils dilated, equal and reacting to light. Knee-jerks diminished. Kernig's, Brujinski's, and Babinski's signs present.

Organism: Type I meningococcus.

Treatment.—Lumbar puncture was done, and 25 c.c. anti-meningococcic serum administered on admission. Chloral and bromide were administered when necessary, also stimulants.

Patient died February 1, 1917. Condition unchanged prior to death.

Case No. 15.—Pte. B.

Was admitted February 9, 1917. Date of onset of symptoms not known. Temperature on admission 101.4° F., and pulse-rate 88.

Symptoms were as follows:—

Some headache, stiffness of the limbs and trunk, mouth and throat very foul and septic, pupils dilated, equal, reacted to light, knee-jerks diminished, plantar reflex absent. Kernig's sign present.

Organism: Type I meningococcus.

Treatment.—Lumbar puncture done, and 25 c.c. anti-meningococcic serum given on admission. One dose of diphtheria antitoxin given on February 10, 1917, and increasing doses of anti-meningococcus vaccine given every three days. No further puncture was done until March 7, 1917, when, since the symptoms were increasing, a second puncture was done, and 25 c.c. of anti-meningococcic serum given.

There was marked coma in this case, with persistent constipation and vomiting. This had persisted to date. There was marked general weakness (notes made about June 1, 1917).

Case No. 16.—Pte. B.

Admitted February 23, 1917. Onset of symptoms four days previously. Temperature on admission 97.2° F., pulse-rate 48. After twelve hours pulse-rate 56, temperature 102.2° F.

Type of organism not discovered.

Symptoms were as follows:—

General headache, backache and stiffness of the limbs, delirious at times, head retraction and marked opisthotonos, pupils dilated and equal, react to light, knee-jerks increased. Kernig's and Brujinski's signs present.

Treatment.—Lumbar puncture was done, and 25 c.c. anti-meningococcic serum administered on admission, and a second lumbar puncture done on February 10, and 25 c.c. anti-meningococcic serum administered. Anti-meningococcus vac-

cine was given subcutaneously in increasing doses; 25 c.c. serum was given intramuscularly February 17.

Recovery was complete with no bad effects.

Case No. 17.—Pte. O.

Was admitted April 3, 1917. Onset of symptoms three days previously. Temperature on admission 101° F., pulse-rate 80.

Symptoms were as follows:—

Headache, stiffness of the neck, back and limbs, profuse petechial rash, pupils dilated and reacted to light, slight head retraction. Knee-jerks increased. Kernig's and Babinski's signs present.

Organism: Type II meningococcus.

Treatment.—Lumbar puncture was done on admission, and 25 c.c. anti-meningococcic serum administered. Meningococcus vaccine was given in increasing doses. No further lumbar punctures done.

Patient made an uneventful recovery.

Case No. 18.—Pte. C.

Was admitted May 5, 1917. Three weeks before admission patient had herpes around his mouth, which healed readily. Twenty-four hours before admission headache in occipital region, aching of the back and legs, pupils equal and reacted to light. Neck rigidity fairly marked. Kernig's sign present.

Organism: Type III meningococcus.

Treatment.—Lumbar puncture on admission, and 25 c.c. anti-meningococcic serum administered. Similar treatment on second, fourth, and sixth days.

Patient made an uneventful and complete recovery.

Patient was apparently doing well for about twenty days, when he suffered a relapse and grew steadily worse, and died two weeks later—August 1.

Case No. 19.—Pte. B.

Was admitted March 23, 1917. Symptoms began March 20, 1917. Temperature on admission 100.6° F., and pulse-rate 76.

Symptoms were as follows:—

Headache, vomiting, pain in the lumbar region, stiffness of the neck, pupils unequal, left dilated, reacted to light. Kernig's and Brujinski's signs present. Well-marked purpuric rash.

Organism: Type II meningococcus.

Treatment.—Lumbar puncture was done daily for the first eight days in hospital, fluid withdrawn, and from 20 to 40 c.c. anti-meningococcic serum administered. Bowels regulated.

Case was severe, but made a complete satisfactory recovery with no after-effects.

Case No. 20.—Spr. R.

Was admitted February 16, 1917. Symptoms probably began February 11, 1917, about five days previously. Temperature on admission 98.8° F., pulse not recorded.

This case is recorded as presenting a singular absence of all the usual symptoms. There was headache and vomiting, and during the last twenty-four hours of life a slight purpuric rash. Opisthotonos, Kernig's and Brujinski's signs are said to have been absent. He was not diagnosed as a case of cerebrospinal meningitis until twenty-four hours before death, and received no specific treatment whatever.

Organism: Type not discovered. Diagnosis made on the finding of a Gram-negative diplococcus in the spinal fluid.

Death occurred February 17, 1917.

Case No. 21.—Pte. G.

Was admitted May 6, 1917. For three weeks previous to this date had had sores in and around the mouth, but no serious illness. Was taken ill quite suddenly in the morning, and admitted to hospital in the evening in an unconscious condition. Temperature 102° F., and pulse-rate not recorded.

Symptoms:—

Headache, vomiting, pupils equal but did not react to light, marked proptosis of right eye. All the cardinal signs recorded as absent.

A provisional diagnosis of brain tumour was made. Lumbar puncture done on morning of 18th to exclude meningitis. Fluid turbid and contained a Gram-negative diplococcus. No growth was obtained. Patient died at 1 p.m. February 18, a little over twenty-four hours after admission.

The confusing point in diagnosis was the proptosis. Autopsy showed the right coronal sinus full of pus under considerable pressure. This had apparently passed out along the optic nerve, causing protrusion of the eye.

Case No. 22.—Spr. G., aged 33.

Was admitted March 3, 1917. Symptoms began March 1,

1917, two days previously. Temperature on admission was 102° F., pulse-rate 98.

Symptoms were as follows:—

Headache, photophobia, pain in lumbar region, neck rigidity, vomiting, herpes, purpuric rash, partially conscious on admission. Kernig's and Brujinski's signs present.

Organism: Type II meningococcus.

Treatment.—Lumbar puncture was done daily, and 20 c.c. of anti-meningococcic serum administered. Morphine gr. ¼ when necessary for delirium.

Patient was in almost constant delirium. Died March 14, 1917, eleven days after admission.

Case No. 23.—Spr. W., aged 24.

Was admitted March 3, 1917. Symptoms began March 1, 1917, two days previously. Temperature on admission 101° F., pulse-rate 86.

Symptoms were as follows:—

Headache, photophobia, neck rigidity, pain in lumbar region, vomiting, herpes, slight purpuric rash, pupils dilated. Kernig's and Brujinski's signs present.

Organism: Type II meningococcus.

Treatment.—Lumbar puncture on admission, and injection of 20 c.c. anti-meningococcic serum. Whenever the temperature rose too high puncture was repeated and serum given.

Unconsciousness was a marked feature in this case. Death occurred April 9, 1917, after an illness of thirty-seven days.

SUMMARY.

After two years' work in a laboratory serving an extended area as regards cerebrospinal meningitis, it would seem that certain points should be emphasized in connection with the disease.

Early diagnosis of the disease should be pointed out particularly as of the utmost importance. However, this does not mean that in every case of headache (the most common symptom of meningitis) the laboratory should be notified, and perhaps necessitate a drive of twenty or thirty miles. In one day two requests were received at this unit to send an officer to perform lumbar punctures on suspicious cases of meningitis. One case was thirty-five miles from here, and the other eighteen miles away. An officer was sent, and found practically no evidence of meningitis in either case. The fluids were clear, and the men had no symptoms that might not have been due to constipation.

As to treatment. A case of meningitis should have constant attention and careful nursing.

Rules should be laid down as to the actual treatment of military cases, and these should be carried out. It seems from our observations that the medical officer in charge may use any method he may think fit, whether it has any scientific basis or not.

Records should be kept of the cases on forms furnished by the military authorities.

CHART I.

SHOWING CULTURAL CHARACTERISTICS OF FOUR TYPES OF MENINGOCOCCI.

Number of plates examined	Type (agglutination)	Pigment	Size: small, medium or large	Consistency: "plime," positive or negative	MICROSCOPICAL EXAMINATION		
					Granular or non-granular	Pigmented or non-pigmented	Margin, clear-cut or serrated
9	I	6:+++ 3:Negative	9:Medium	2:Positive 7:Negative	2:+++ 7:Negative or	2:+++ 7:Negative	2:Serrated 7:Smooth
9	II	6:+++ 3:Negative	9:Medium	2:Positive 7:Negative	2:+++ 7:+	2:+++ 7:Negative	9:Smooth
1	III	+++	Small	Negative	+	Pale	Smooth
1	IV	+++	Medium	Negative	++	+++	Smooth
30	Negative	21:+++ 9:Negative	9:Small 21:Medium	4:Positive 26:Negative	3:+++ 27:+	13:Negative 18:+++	29:Smooth 1:Serrated

+ negative = to indicate degree.

CHART II.

SHOWING 32 CASES OF CEREBRO-SPINAL FEVER WITH NUMBER OF POSITIVE CONTACTS, AND TYPES FOUND.

Area	Case	1st swab	Type of organism from case	Number of contacts	TYPES					PERCENTAGE POSITIVE		
					Pos.	1	2	3	4	Same as case	Other types	Total
Dover	Waller, Pte.	14.3.17	—	14	1	—	—	—	1	—	—	7·—
"	Fox, C., Pte., 49059	16.3.17	2	30	2	1	1	—	—	3·3	3·3	6·6
"	Stephens, L/C., 12845	23.3.17	2	8	4	2	2	—	—	25	25	50
"	Pocock, Pte., 27388	25.3.17	1	36	6	—	4	—	2	Not	16·6	16·6
"	Clements, Pte.	2.4.17	4	34	6	2	4	—	—	17·6	17·6	17·6
"	Goddard, Pte., 33279	13.4.17	1	16	4	2	2	—	—	12·5	12·5	25
"	Jerrard, Gnr., 150269	17.4.17	—	6	2	2	—	—	—	Not	33	33
"	Wheeler, L/C.	26.4.17	1	7	1	—	2	—	—	14·3	14·3	14·3
Shorncliffe	Pierce, Pte., 187135	10.3.17	1	55	3	—	3	—	—	5·4	5·4	5·4
"	Egan, Pte., 248585	10.3.17	2	34	1	—	1	—	—	2·9	Not	2·9
"	Mason, Pte., 681498	23.3.17	3	38	1	—	1	—	—	Not	2·6	2·6
"	MacKenzie, Capt.	17.2.17	1	56	3	—	3	—	—	5·3	5·3	5·3
"	Gibson, F., 90998	13.4.17	—	43	4	2	2	—	—	4·0	4·0	9·3
"	Moulton, L/C.	22.4.17	1	23	2	—	2	—	—	8·7	8·7	8·7
Canterbury	Balfour, Pte., 220805	23.3.17	2	16	1	—	1	—	—	6·2	Not	6·2
"	Roberts, Pte., 7317	9.3.17	2	10	2	1	1	—	—	10	10	20
Folkestone	Collard (civilian)	15.2.17	2	5	—	—	—	—	—	—	—	—
"	Ravenette (civilian)	15.2.17	4	3	—	—	—	—	—	—	—	—
"	Fenn, Mrs. (civilian)	22.2.17	1	10	—	—	—	—	—	—	—	—
"	Rudolph, B. (civilian)	14.4.17	1	89	3	1	2	—	—	Not	2	3
"	Crouch, P. (civilian)	1.3.17	1	4	—	—	—	—	—	—	—	—
Sandwich	Kimberly, 233389	14.2.17	2	58	2	1	1	—	—	1·7	1·7	3·4
"	Russell, 228157	18.2.17	—	38	2	—	1	—	1	—	—	5·2
"	Wooley, 235994	4.3.17	2	71	2	—	2	—	—	2·9	—	2·9
"	Goble, Spr., 215389	4.3.17	2	64	—	—	—	—	—	—	—	—
"	Ridge, Pts., 204165	5.3.17	—	—	—	—	—	—	—	—	—	—
"	Owen, Spr., 222566	5.4.17	2	31	7	2	3	—	2	9·7	12·9	22·6
Herne Bay	Savage, Pte.	31.1.17	1	11	—	—	—	—	—	—	—	—
"	Goodenough, Pte.	6.5.17	—	28	1	1	—	—	—	—	1	3·4
Whitstable	New, F., 265973	12.3.17	2	204	3	—	3	—	—	1·5	—	1·5
Hythe	Robinson, A., 32297	13.3.17	—	11	—	—	—	—	—	—	—	—
"	Boettcher	23.1.17	2	40	1	—	—	—	—	—	2·5	2·5
Minster	Bush, Pte.	9.2.17	1	11	—	—	—	—	—	—	—	—
"	Coates	8.5.17	3	36	7	3	3	1	—	2·7	16·6	19·3

CHART III.
CLINICAL FEATURES OF TWENTY-FIVE CASES OF CEREBRO-SPINAL FEVER TABULATED.

Case	Headache	Vomiting	Photophobia	Herpes	Pyrexia on admission. Degrees	Pulse on admission	Pupils	Neck rigidity	Reflexes	Kernig's	Rash
1	Positive	Positive	Positive	Positive	102	76	Equal, react slowly to light	Positive	Babinski's sign present	Positive	Negative
2	"	"	"	Negative	103	96	Equal, but react slowly to light	"	Exaggerated	"	"
3	"	"	"	Positive	103.4	110	Equal, some nystagmus	"	Babinski's sign present	"	"
4	"	"	"	"	104	130	Equal, nystagmus	"	"	"	"
5	"	"	"	Severe	103.6	135	Equal, squint	"	"	"	"
6	"	Negative	"	Positive	103	94	Equal and react to light	"	"	"	"
7	Unconscious on admission			Negative	102	180	Dilated lateral strabismus Dilated	"	Not reported	"	"
8	Positive	Positive	Negative	Positive	99.2	108	Dilated	"	"	Not reported	Well marked
9	Not reported	Not reported	"	Negative	101	94	Normal	"	"	"	Negative
10	Positive	Negative	"	"	103	72	Not reported	"	"	Positive	Well marked
11	"	Positive	"	"	98.8	60	Normal	"	Exaggerated	"	"
12	"	"	"	Positive	101.6	120	Not reported	"	Not reported	"	Negative
13	"	Negative	Positive	Negative	103.8	80	Dilated and reacted to light	"	Knee-jerks lessened	"	"
14	Delirious on admission			"	103	48	Nystagmus. Dilated. React to light	"	Babinski's sign present	"	"
15	Positive	Positive	Positive	"	101.4	88	Dilated. React to light	"	Knee-jerks diminished	"	"
16	"	Negative	Negative	"	97.2	48	Dilated. Equal and react to light	"	Knee-jerks increased. Babinski's sign	"	"
17	"	"	"	"	101.4	80	"	"	"	"	Positive
18	"	"	"	"	Not recorded	Not recorded	Normal	"	Not recorded	"	Negative
19	"	Positive	"	"	100.6	76	Left dilated, both react to light	"	"	"	Positive
20	"	"	"	"	98.8	Not recorded	Equal, no react to light	Negative	"	"	Positive
21	"	"	"	"	102	"	Marked proptosis of right eye Dilated	"	"	Negative	Negative
22	"	"	Positive	Positive	102	98	"	Positive	"	Positive	Positive
23	"	"	"	"	101	86	"	"	"	"	Slight

Rash occurred in 35 per cent. of cases.

Herpes occurred in 43 per cent. of cases.

At the present time in this laboratory we refuse to swab contacts of cases occurring in the area served by us, unless we have seen the case or have had a specimen of the fluid for examination.

Many of the questions concerning carriers are still unanswerable, but it would seem that properly fitted-up huts should be established in each area to serve a certain number of men. Any carriers could be sent to this place for proper and careful treatment, either with steam atomizers or by any other effective method which might be recommended by specialists in this work from time to time.

CONCLUSIONS.

- (1) Legumin tryptic agar is the best medium for routine culture and study of the meningococcus.
- (2) Agglutination of an organism isolated is the only way by which it can be definitely identified.
- (3) Organisms of different types may be isolated from the same throat at different times.
- (4) There is no relation between the type of the organism and the seriousness of the case.
- (5) Although epidemics may be checked, the Levick sprayer apparently has little effect on actual carriers when treated in groups.
- (6) More attention should be paid to early diagnosis of cerebrospinal fever.
- (7) Methods for treatment for soldiers should be outlined and insisted upon.
- (8) With more careful nursing and observation by specialists the mortality-rate generally would be lowered.
- (9) The serum treatment, combined with thorough draining of the fluid at regular intervals, is the most effective.
- (10) Since this unit took over the meningitis work of this

district in 1915 a carrier has never developed cerebrospinal fever.

NOTE.

Since writing the above Gordon's work in isolating the meningococcus endotoxin has been published. Theoretically, it would seem that if antitoxin can be prepared (and that, we are assured, has been accomplished) a great advance has been made in the treatment. Direct neutralization of the toxins by injection of antitoxin, instead of, or combined with, immune sera, should be the ideal method of treating the disease.

REPORT ON A SERIES OF GASED CASES.

By MAJOR S. G. ROSS, C.A.M.C.,

AND

CAPTAIN A. T. HENDERSON, C.A.M.C.

DURING the period from November 2, 1917, to November 13, we were in charge of the Canadian Corps Gas Centre. In this time a fair number of cases were treated and evacuated through this station. The following notes have been taken on a series of consecutive cases, constituting rather more than half the total admissions.

CLASSIFICATION BY SERVICES.

Of these cases, 55 per cent. occurred in the Infantry, 27 per cent. in the Artillery, and other services provided 17 per cent.

CAUSES OF CASUALTIES.

Without attempting to give statistics of the relative frequency with which one or other condition was operative,

interrogation of the men showed that the following causes of gassing came into play, i.e., causes why box respirator failed to afford protection.

(1) *Lack of Warning.*—(a) Through gas shell exploding in the immediate neighbourhood. (b) Through men being asleep, or no warning being given by gas guard, or no gas guard posted.

(2) *Not Recognized.*—(a) Gas shell mixed with H.E. bombardment. (b) Insidious. Small concentration of gas unnoticed, or men working in contaminated ground.

(3) *Recognized, but sufficient Precautions not taken.*—(a) Rank carelessness. (b) Neglect of precautionary measures in small concentrations of gas. (c) Inability to carry out work while wearing box respirator on account of darkness, e.g., in the case of gun-layers, of whom there were a number. In other cases the increased efforts required in doing heavy work while wearing box respirator often caused men to remove these, e.g., stretcher-bearers. (d) Faulty orders. In some cases superior officers caused box respirator to be removed too early.

(4) *Faulty Respirator.*—Very few cases resulted from this cause. In one case the box respirator was worn incorrectly, being covered by some equipment, thus preventing quick adjustment.

(5) *Reason for Gassing not Established.*

PERIOD ELAPSING BETWEEN EXPOSURE AND ADMISSION.

The cases were admitted any time from six hours to a week after being gassed.

Latent Period.—In the majority of cases symptoms appeared from one hour to three days after exposure. Among the early symptoms were irritation of the eyes, burning sensation in throat and chest, sneezing and vomiting, but no definite rule could be established as to the order in which the different symptoms appeared.

DESCRIPTION OF GAS BY CASUALTIES.

The odour of the gas was variously described as like "mustard," like "garlic," "strong," "pungent." Others smelt a gas with a sweetish musty or sickly odour (probably phosgene). A gas with a pineapple odour was also smelt. Unusual descriptions of the gas were that it smelt like "Tommy's cooker," "stewed rhubarb," "ammonia," "vinegar," "new baked bread," "new varnish." Many could not describe the smell, and a number did not smell it at all. A few men noticed a yellow patch on the ground where the gas shell had exploded.

SYMPTOMS AND SIGNS.

Eyes.

Seventy-two per cent. of the cases complained of soreness in the eyes at some period. Of these, 47 per cent. showed conjunctivitis on admission. 20 per cent. were severe cases, having marked inflammation of the conjunctivæ and suffering from pain, photophobia, and spasm of the eyelids. Only one case had a definite keratitis. He had been gassed twenty-four hours before admission as the result of a shell bursting 6 ft. away. One eye only showed marked conjunctivitis and keratitis. From this it would appear that some of the liquid from the gas shell had spluttered into this eye. Oedema of the eyelids accompanied a number of the cases of conjunctivitis. The eye symptoms, in cases questioned on this point, came on in from two hours up to two days after exposure. Four men, however, stated that their eyes had become sore immediately after gassing. The conjunctivitis appeared as soon as nine hours after being gassed. A medical officer of an infantry battalion who had been gassed stated that soreness of the eyes was the first symptom. In his case the conjunctivitis was very marked, and from his evidence we gathered that the pain was severe.

Nose and Throat.

Irritation of the nose and the throat was a frequent effect. A history of sneezing shortly after being gassed was given by 55 per cent. of all cases. A large proportion of these men had coryza (46 out of the last 153 cases examined). Most of these had a profuse watery discharge from the nose.

Seventy per cent. complained about their throat. Symptoms were variously described as "tickling," "dryness," "choking," "itchy," "raw," "prickling like needles," "difficulty in swallowing," "hoarseness."

Pharyngitis was commonly present. The larynx was commonly affected in 63 per cent. of our series. 20 per cent. were

classified as slight, 50 per cent. moderate, and 30 per cent. severe. As direct examination was impossible, the classification of the laryngitis was made on the basis of symptoms and the degree of hoarseness and aphonia. Whilst in a certain number of cases the throat was affected early, in many the symptoms did not develop until from one to three days after gassing. We got the impression that the larynx was more affected than other parts when the concentration was mild and the men exposed for a considerable length of time. In one battery where the guns were located in a hollow, the gunners said that the smell could almost always be detected. A gunner sergeant stated that half the men of his battery were evacuated gassed during their stay of three weeks in that position, and in most cases the effects came on slowly. Three of these cases had a marked laryngitis, but showed no conjunctivitis, and other effects were slight.

Chest.

Pain.—Another common symptom was that of pain in the chest. 57 per cent. of the men complained of this. It was described variously as "soreness," "tight feeling," "burning sensation," "catching of breath." In the great majority of cases it was felt in the substernal region. A few men had pain localized to one side of the chest. This appeared to be a pleural type.

Cough.—This was present in 80 per cent. of the cases, usually dry and hacking in character and often very troublesome. In no cases was expectoration noted.

Bronchitis.—Physical signs of bronchitis were present in 15 per cent. of cases. We classified it under three headings. 47 per cent. were slight, 50 per cent. moderate, and 3 per cent. severe. Most of these showed medium and coarse dry râles on auscultation. Three cases showed signs of pleurisy; pain in the chest with pleural râles at site of pain. In only one case did pneumonia seem to be developing.

Dyspnoea.—27 per cent. complained of dyspnoea. 66 per cent. of these stated that it was only present on exertion, and very few were actually observed to be short of breath. One man, a case of phosgene poisoning, had marked dyspnoea. A number of the men complained of a smothering sensation in the chest.

Cyanosis.—Only 6 per cent. of cases showed cyanosis, mostly slight. In one case of phosgene poisoning it was very mild. In this connection we might add that a large number of the men showed a peculiar suffusion of the face, which we have thought might be a result of the wearing of the box respirator.

Circulatory System.

Beyond quickening of the pulse in some cases, we found no evidence of the heart being affected in cases of Yellow Cross gas poisoning. One man had a definite arrhythmia (extra systole), probably a coincidence. One severe case of phosgene poisoning showed cardiac collapse for a time.

Gastro-intestinal System.

Vomiting.—Vomiting was a fairly constant symptom, being present in 60 per cent. of cases; 10 per cent. had nausea without vomiting. Several more complained of retching. Vomiting often was the first symptom, coming on as soon as five minutes after gassing. In other cases it was not complained of until two days later. Certain men did not vomit until food was eaten. One man who had drunk water from a shell hole began vomiting ten minutes afterwards, and suffered from pain in the epigastric region, and the stretcher-bearers stated that the vomitus smelled of gas. The stomach appeared to be irritable for some days after the men had been gassed. This we noticed in certain of our own men whom we did not evacuate.

Abdominal Pain.—Abdominal pain was complained of by 19 per cent. It was nearly always referred to the epigastrium, and was stated to be of a steady burning character. Only one man had crampy pains.

Diarrhoea.—Diarrhoea occurred in 2 per cent. of the series. One man suffered from a severe diarrhoea with bloody stools, lasting thirty-six hours. He stated that the same thing had occurred before when he was gassed at Vimy. In one of the cases diarrhoea lasted for a week.

Skin.

Twenty-four per cent. of the cases showed definite skin lesions. One half of these had blistering. The remainder showed first degree burns only. We noticed burns as soon

as nine hours after gassing. A medical officer on admission, eighteen hours after being gassed, showed no burns. Twelve hours later blisters developed on his hands, probably the result of handling contaminated clothing. The burns were located in the following places in the order of their frequency: Buttocks and thighs, hands, legs, arms, back, face, neck, scrotum, abdomen. The blistering was often extensive and severe. In one case the blisters were distinctly yellow, and the serum resembled picric acid solution. In another the lips were burned, and the tongue showed patches where the epithelium was denuded. A group of men who had been digging a trench all developed burns on the hands and forearms. Evidently the ground where they were working had been contaminated by the gas. The relatively large proportion of burns of the buttock was evidently due to men sitting on contaminated ground, usually in a new shell hole. In another case a man slipped off a trench mat and got one leg into a shell hole containing water. Burns developed on this leg the following day. The man had no other signs or symptoms of having been gassed.

The burns were not especially painful, and in some cases had not been noticed at all.

Constitutional Effects.

Headache.—78 per cent. of the cases complained of headache at one time or another. Headache was moderately severe. A few men suffered from dizziness.

Syncope.—Three men gave a history of collapsing or fainting. In each case the man had carried on for some time after being gassed. Two of these cases were phosgene.

Weakness and Muscle Pain.—A number of cases complained of weakness and pains in the muscles.

Jaundice.—One man only showed definite jaundice.

Temperature.—Forty-three cases showed a temperature of 99° or over on admission, and of these thirteen had a temperature of over 100°. Bronchitis was present in ten of these cases, and the fever of the remainder might be accounted for by laryngitis or burns.

Pulse.—11 per cent. had a pulse of 90 or over, under half of these associated with fever.

Respiration.—A few cases only showed increased respiratory rate.

TYPE OF GAS.

The vast majority of cases seemed to be due to the Yellow Cross gas. A few were doubtful and may have been the result of mixed gas. Only three seemed to be definite cases of phosgene poisoning. These all showed the characteristic delayed action of phosgene, i.e., collapse after a period of time. They gave a history of having noticed the characteristic sweetish, musty odour of that gas, and they showed none of the special effects of Yellow Cross gas. One of these cases was admitted in a moribund condition. He was collapsed, semi-conscious, pulse barely perceptible at the wrist, his breathing was shallow and noisy, and the skin showed a dusky pallor. The lungs were oedematous, the body cold, and the patient was vomiting. Treatment consisted in the application of heat externally. Oxygen was administered, and carried on intermittently for the next twelve hours. At the end of several hours pulse was easily felt and the colour had improved. Patient had become conscious, but was still vomiting. Later on the pulse became weaker. A hypodermic of strychnine one-fifteenth of a grain was administered, the foot of the bed raised, and the legs bandaged. Seemingly, as a result of this, the patient's condition improved. The vomiting ceased about this time, and he was able to take a small amount of whisky by mouth. He now began to complain of pain in the right side of chest. Morphine was given and he went to sleep.

Before being evacuated eighteen hours after admission his condition was much improved, pulse fair, some cyanosis, breathing quickened and catchy, temperature 101° F. Examination of the chest showed the oedema had disappeared. A generalized bronchitis was present and fine râles could be heard at both bases. In the right axilla a pleural rub was detected. Patient was probably developing pneumonia.

There were a few instances of lachrymatory gas being mixed with Yellow Cross gas. The great majority of Yellow Cross cases were mild as regards the constitutional effects, although often showing severe burns, conjunctivitis, and laryngitis. As the cases were held for only a short time we can give no idea of their subsequent history. Examination of the urine was not done.

The treatment employed in these cases was according to the detailed instructions laid down, we understand, first by the D.D.M.S. Canadian Army Corps, to be used in all Canadian Corps gas centres, and subsequently with relatively little modification adopted for the B.E.F. in general.

A GRAPH, WITH NOTES, EMPHASIZING THE IMPORTANCE OF THE EARLY DIAGNOSIS AND TREATMENT OF PRIMARY SYPHILITIC LESIONS.

A. B. JACKSON, M.B.Tor.; Captain C.A.M.C.; Pathologist, Canadian Hospital, Etchinghill.

WHEN the virus of syphilis enters the tissues of man, there is no clinical evidence to show that such is actually the case, until some days later, when the primary lesion becomes manifest. Thus the virus is present in the initial lesion during the so-called incubation period. This is, on the average, about three weeks, although, in many cases, it is much shorter.

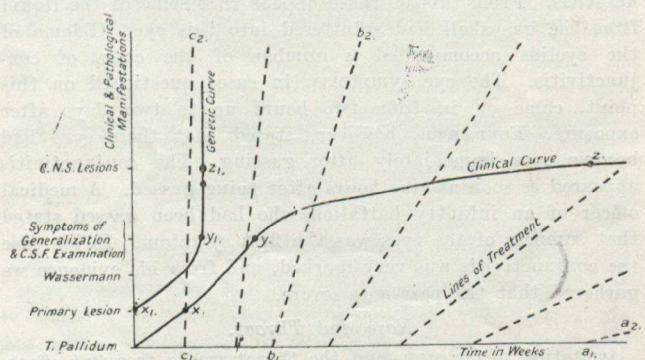
The clinical evidence of generalized syphilis is manifest about four weeks after the appearance of the primary lesion. As it takes approximately three weeks for the virus to produce a primary lesion, it is not impossible that the virus has been in the site of the generalized lesions three weeks prior to the clinical manifestation.

The virus can obtain access to all parts of the body only by means of the blood-stream.

Following the same line of thought, therefore, the virus must be circulating in the blood-stream three weeks before the signs of generalized syphilis appear. Neisser [1], Hoffmann [2], Kaplan [3], Plaut [4], and others have shown that this can be the case. Or, to emphasize the point, the virus is generalized a week after the primary lesion is clinically apparent, if not earlier.

The Wassermann reaction becomes positive before the generalized stage is clinically evident. It is not uncommon to find the Wassermann reaction positive in cases with primary lesions but of a few days' duration. The Wassermann reaction, becoming positive, indicates the generalization of the virus.

If it takes a few weeks for the virus to cause pathological change in skin, mucous membrane, &c., it is possible that such is the case in other tissues. As pathological changes are found in the cerebrospinal fluid in a large percentage of generalized syphilitics, it means that the virus reaches the central nervous system very early in the course of the disease. In fact, this takes place when the virus is abundant in the blood-stream, in the so-called primary stage. Clinical evidence of involvement of the central nervous system is often years in appearing. But cerebrospinal fluid examinations show how early involvement of the central nervous system actually takes place. This has been clearly shown by Dreyfus [5], Gennerich [6], Mills [7], and others.



This information can be exemplified by a graph, as in the accompanying figure; the abscissa, representing time, in weeks; the co-ordinate representing the clinical and pathological changes.

Thus, the primary lesion appears three weeks after infection, as shown at x. But the infection of the primary lesion actually took place three weeks before, shown by x₁.

Likewise, clinically, generalized syphilis appeared four weeks after the primary lesion was apparent, as shown by y.

Actually these lesions began some three weeks before, represented by y_1 .

In like manner the cerebrospinal fluid shows pathological changes in the generalized stage, and this is also represented by y_1 .

Clinical evidence of involvement of the central nervous system is late in appearing, years in many cases, being shown by z . As shown by cerebrospinal fluid examinations in early cases, it is found that the infection actually took place during the generalization of the virus, namely, z_1 .

Thus there are two curves, one representing the clinical course of the disease, the other representing the actual beginning of each particular lesion. These curves I designate, respectively, the clinical curve and the genetic curve.

The great danger in syphilis is not the initial lesion or the lesions of generalized syphilis, but lesions of the central nervous system. It is this type of case that is of grave national import.

Mott [8] says, "When once the trypanosome organism (*Treponema pallidum*) has entered the cerebrospinal fluid it is doubtful if it can ever be eradicated."

Therefore, the ideal treatment would be to prevent involvement of the central nervous system. Examining these curves, it seems almost hopeless to attain this. There is barely time to recognize the primary lesion before the central nervous system is involved. Therefore, it is of the utmost importance to diagnose the primary lesion quickly and accurately, and inaugurate treatment at once.

It is a good axiom to consider every sore of the genitals as syphilitic, until proved otherwise.

It is generally accepted that the longer the central nervous system has been involved, the more difficult it is of cure. The only hope is to check the process.

Harrison [9] has shown that the Wassermann reaction is more difficult to render negative in generalized cases than in primary cases which have positive Wassermann. Also, that it is more difficult in the later cases than in primary cases which have negative Wassermann.

Thus lines of treatment may be drawn on the graph. If treatment be delayed until the central nervous system becomes clinically involved, as at a_1 , before inaugurating treatment, it is doubtful whether the individual can ever be cured, so that the line of treatment, beginning at a_1 , proceeds at an acute angle, and does not intersect the clinical curve.

But if treatment is inaugurated early at b_1 , it is possible to render the Wassermann reaction negative and free the patient of all clinical evidence of the disease.

If treatment is inaugurated as soon as the primary lesion appears at c_1 , when the patient has a negative Wassermann reaction, there is hope of preventing even the involvement of the central nervous system. In other words, the c_1 - c_2 line of treatment intersects the genetic curve, and the virus is prevented from gaining access to the central nervous system.

Therefore, it is absolutely essential for successful antiluetic treatment to diagnose and treat the disease as soon as the primary lesion becomes apparent.

The purpose of this graph is to simplify and emphasize the importance of the early diagnosis and treatment of primary syphilitic lesions.

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- [9] HARRISON, L. W. *Brit. Med. Journ.*, May 5, 1917.

The "Medical Supplement."

INFORMATION has been received from the Medical Research Committee that the June and subsequent numbers of the valuable *Medical Supplement*, published by them, and issued by the General Staff, War Office, are placed on sale, and are obtainable either directly or through any bookseller from H.M. Stationery Office (Imperial House, Kingsway, London, W.C.2), price one shilling net per copy. This arrangement does not affect the distribution of official copies. There will doubtless be many officers of the C.A.M.C. who desire to possess for themselves copies of this most valuable periodical.

MEETINGS OF CLINICAL SOCIETIES.

MEDICAL SOCIETY OF THE GRANVILLE CANADIAN SPECIAL HOSPITAL, BUXTON.

THE monthly meeting of the Granville Canadian Special Hospital Medical Society was held in the main building on Wednesday, May 9, 1918, at 8 p.m., Colonel J. T. Clarke, C.A.M.C., in the chair. Major F. H. MacKay was elected President by acclamation, in place of Lieutenant-Colonel A. MacKenzie, returned to Canada.

Major Robson presented his special *Apparatus for the Intra-tracheal Administration of an Anæsthetic*. He reviewed briefly the history of anæsthesia and the evolution of the different methods. He claims the following advantages for his apparatus. (1) Ether vapour delivered near the bifurcation of the trachea, thus eliminating the dead space. (2) Ether vapour delivered at body temperature. (3) A moist ether vapour is used. (4) No post-operative vomiting. (5) Economy of ether.

Captain W. F. Dey presented two cases of *Hysteria in the Male*.

(1) Hysteria simulating cerebellar lesion. Private S., No. 894291, C.L. Battalion. In August, 1915, he was dragged a distance in a stirrup, and was unconscious for three weeks; clear mentally when in England October, 1915. Sent to Depot December, 1915, and was returned to France December, 1916. Immediately on return to France he noticed unsteadiness on his feet, and the appearance of severe headaches every second or third day. There was a feeling of weight on the top of his head. Symptoms became gradually more severe until April, 1917, when he reported sick. At this time he was staggering all the time as if he were drunk, and the headaches were constant. Sent to hospital, where he was boarded to a Labour Battalion; carried on until January, 1918, when he was sent to England.

On March 15, 1918, he was admitted to Granville Canadian Special Hospital. Examination at this time showed a marked unsteadiness upon his feet, inclining constantly to the left. There was a coarse nystagmus to the left and nystagmus on whirling. Pupils both slightly irregular, left somewhat larger than the right. Reflexes active, discs clear. No sensory or reflex disorders. Clumsy in all movements of the left hand. Wassermann of blood negative. Wassermann of cerebro-spinal fluid negative. Noguchi and colloidal gold tests negative. No cells in the fluid. Other systems normal.

This man was constantly in trouble because of his gait, having been arrested a number of times for being drunk. He walked in a most peculiar way in that he would go four paces when he would lurch to the left; he would recover himself, walk another four paces, and then would lurch to the left again. The staggering became so pronounced finally that the condition was diagnosed entirely functional. On April 29 and 30 he was given wire brush applications, when the gait immediately became normal and station steady.

(2) Gunshot wound of the neck, causing contracture of all muscles. Private M. 525673, 49th Battalion. Went to France April, 1917, wounded August 25, 1917. A bullet entered over the spinous process of fourth cervical vertebra, with exit 2 in. behind and 1 in. below tip of right mastoid process. X-ray report at this time showed fracture of the spinous process of the axis. He was placed in a plaster helmet, which was rigid, with a shoulder plate. Admitted to Granville Canadian Special Hospital April 17, 1917. X-ray showed nothing abnormal. Right pupil slightly larger than left, but this was noticed in childhood. All systems normal. Helmet removed. There was a marked ataxic movement of the legs which could be corrected on effort. After persuasion he could move head slightly; unable to stand alone, great difficulty in walking even with support on both sides because of spasmodic contraction of both legs. Spasm of all muscles of neck and back. With encouragement and by his own effort developed 10 degrees of antero-posterior movement of the neck, but the gait remained the same. With strong wire brush applications the gait became normal and all movements of the neck free.

Captain Patterson presented cases of *Metatarsalgia* and *Pes Planus*. He led in a discussion on the care of soldiers' feet, and pointed out the extreme importance of providing men with shoes that are large enough.

Captain Perry presented a case of *Angioneurotic Oedema* of the hand. He also demonstrated a special splint for fractures of the humerus.

Major Eagar presented a number of X-ray plates demonstrating *Bone spurs* and *Bone atrophy*.

CORPS NEWS.

HONOURS.

THE King has been graciously pleased, on the occasion of His Majesty's Birthday, to give orders for the following appointments for valuable services rendered in connection with military operations in France and Flanders dated June 3, 1918:—

London Gazette, No. 30716, June 3, 1918.

To be additional Member of the Military Division of the Third Class, or Companion of the Most Honourable Order of the Bath: Colonel Arthur Edward Ross, C.M.G.

To be additional Members of the Third Class, or Companions of the Most Distinguished Order of Saint Michael and Saint George: Colonel John Munro Elder; Colonel Arthur Evans Snell, D.S.O.

AWARDED THE DISTINGUISHED SERVICE ORDER.

Lieutenant-Colonel George Joseph Boyce; Lieutenant-Colonel Anson Scott Donaldson; Major George Herbert Rae Gibson; Lieutenant-Colonel Archibald Lorne Campbell Gilday; Lieutenant-Colonel John Nisbet Gunn; Lieutenant-Colonel Joseph Hayes; Lieutenant-Colonel Daniel Paul Kappel; Major Theodore Adolf Lomer.

AWARDED THE MILITARY CROSS.

Captain (Acting Major) William Theodore Ewing.

AWARDED THE DISTINGUISHED CONDUCT MEDAL.

No. 33302 Staff-Sergeant S. H. Bye; No. 33246 Sergeant-Major C. E. McArthur.

His Majesty the King has been graciously pleased, on the occasion of His Majesty's Birthday, to award the Royal Red Cross Decoration to the undermentioned ladies of the C.A.M.C. Nursing Service in recognition of their valuable services with the Armies in France and Flanders:—

London Gazette, No. 30716, June 3, 1918.

AWARDED THE ROYAL RED CROSS, FIRST CLASS.

Nursing Sister A. B. Armstrong; Nursing Sister L. Pidgeon; Nursing Sister K. Shaw.

AWARDED THE ROYAL RED CROSS, SECOND CLASS.

Nursing Sister E. M. Auger; Nursing Sister M. Bliss; Nursing Sister I. C. Brady; Nursing Sister I. Davies; Nursing Sister L. N. Gray; Nursing Sister E. Pierce; Nursing Sister F. A. Rice; Nursing Sister G. Spalding; Nursing Sister S. E. Young; Nursing Sister C. L. Younghusband.

The King has been graciously pleased, on the occasion of His Majesty's Birthday, to give orders for the following appointments for services in connection with the War:—

London Gazette, No. 30721, June 3, 1918.

To be an additional Member of the Military Division of the Third Class, or Companion of the Most Honourable Order of the Bath: Colonel Alexander Primrose.

To be additional Members of the Third Class, or Companions of the Most Distinguished Order of Saint Michael and Saint George: Colonel George Eli Armstrong; Hon. Lieutenant-Colonel George Washington Badgerow.

The names of the following officers, nursing sisters, N.C.O.'s., and men whose distinguished and gallant services and devotion to duty have been considered deserving of special mention are included in a dispatch from the Field-Marshal Commanding-in-Chief the British Armies in the field, dated April 7, 1918, covering the period September 25, 1917, to February 24-25, 1918:—

STAFF.

Colonel H. A. Bruce; Major G. H. R. Gibson; Major G. G. Greer, M.C.; Colonel H. M. Jacques, D.S.O.; Major T. A. Lomer; Colonel A. E. Ross, C.M.G.; Colonel A. E. Snell, D.S.O.; Colonel R. P. Wright, D.S.O.

CANADIAN ARMY MEDICAL CORPS.

Captain J. E. Barry; Lieutenant-Colonel G. J. Boyce; Captain H. McL. Cameron; Lieutenant-Colonel D. Donald; Lieutenant-Colonel A. S. Donaldson; Colonel J. M. Elder; Major A. W. M. Ellis; Lieutenant-Colonel A. L. C. Gilday; Lieutenant-Colonel J. A. Gunn; Temp. Lieutenant-Colonel J. N. Gunn; Lieutenant-Colonel J. Hayes; Lieutenant-Colonel D. P. Kappel; Quartermaster and Hon. Captain J. E. Lawrence; Major (Acting Lieutenant-Colonel) H. H. Moshier; Major G. S. Mothersill, D.S.O.; Lieutenant-Colonel A. C. Rankin; Captain W. A. Richardson; Temp. Major (Acting Lieutenant-Colonel) E. R. Selby; Lieutenant-Colonel J. Stewart; Major G. S. Strathy; Captain S. J. Streight; Quartermaster and Hon. Captain J. E. Tulloch; Captain W. C. Walsh; Captain H. W. Whytock; Captain H. G. Young, D.S.O.; No. 523605 Private S. Fairham; No. 1384 Private W. J. Pettengell; No. 524773 Staff-Sergeant A. J. Pickman; No. 50842 Quartermaster-Sergeant G. E. Rogers; No. 532359 Corporal J. Tait; No. 1432 Corporal O. E. Thomas; No. 32910 Staff-Sergeant E. T. Westby.

NURSING SERVICE.

Sister Miss L. Brady; Sister Miss C. A. Donnelly; Sister Miss E. E. Carpenter; Sister Miss M. J. Fortescue; Matron Miss M. M. Goodeve; Matron Miss E. MacL. Gordon; Sister Miss R. Hally; Sister Miss S. M. Jenkins; Sister Miss W. M. Lanphier; Sister Miss M. MacDonald; Sister Miss S. Robertson; Matron Miss E. M. Wilson.

The King has been graciously pleased, on the occasion of His Majesty's Birthday, to give orders for the following appointments to the Most Excellent Order of the British Empire for services in connection with the War:—

To be an Officer of the said Most Excellent Order: Lieutenant-Colonel Frank Hamilton Mewburn.

To be Members of the said Most Excellent Order: Quartermaster and Hon. Lieutenant George Thomas Brown; Quartermaster and Hon. Captain William Harris Fox; Quartermaster and Hon. Captain Robert Kirkpatrick. (*London Gazette*, No. 30730, June 7, 1918.)

Promotions.

Temporary Captains H. C. Dixon; W. L. Whitemore, M.C.; H. M. Nicholson; K. E. Cooke, M.C.; C. A. Baragar; W. H. Eagar; G. F. Stephens; G. M. Foster, M.C., to be Temporary Majors. (*London Gazette*, No. 30686 February 17, 1918.)

Temporary Lieutenant-Colonels H. R. Casgrain and J. Stewart to be Temporary Colonels. (*London Gazette*, No. 30700, May 24, 1918.)

Temporary Captain T. W. Moore to be Temporary Major. (*London Gazette*, No. 30715, June 1, 1918.)

Temporary Lieutenant-Colonel J. A. Hutchinson to be Temporary Colonel. (*London Gazette*, M.S. (1b), June 6, 1918.)

Temporary Lieutenant-Colonel E. J. Williams, D.S.O., to be Temporary Colonel. (*London Gazette*, No. 30736, June 8, 1918.)

Temporary Major E. V. Hogan to be Temporary Lieutenant-Colonel. (*London Gazette*, No. 30728, June 5, 1918.)

Struck off Strength.

Being invalided to Canada for further medical treatment: Capt. W. H. Brothers; Capt. T. B. Ramsay; Capt. C. H. Molleur; Lt.-Col. A. L. C. Gilday, D.S.O.; Capt. H. A. Hessian; Qr.-Mr. and Hon. Capt. F. E. Currey; Capt. F. W. Jackson; Capt. F. Hogan; Major J. A. Dickson.

Having relinquished his appointment as Qr.-Mr., C.A.M.C., and being appointed Hon. Lt.-Col. General list: Qr.-Mr. and Hon. Lt.-Col. H. W. Blaylock.

Being retained in Canada for duty: Major H. E. Paul; Col. E. G. Davis, C.M.G.; Major R. C. Armour; Major J. W. Hutchinson; Major C. McMane; Major S. N. Polson; Major L. M. Rice; Capt. G. H. Manchester; Capt. J. W. Woodley, M.C.; Qr.-Mr. and Hon. Capt. L. T. Trump; Qr.-Mr. and Hon. Capt. F. Poock; Major W. H. Ballantyne; Major J. L. Todd; Capt. E. K. MacLellan.

Being returned to Canada: Qr.-Mr. and Hon. Capt. E. G. Sergeant; Capt. T. R. Brownridge.

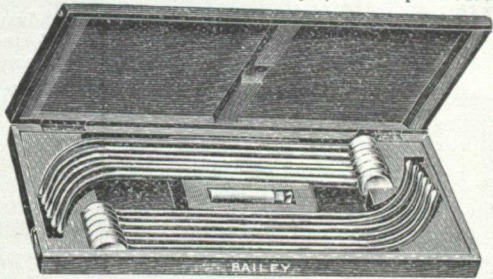
Having died of wounds: Capt. E. E. Meek, May 30, 1918; Nursing Sisters G. M. M. Wake, D. M. Y. Baldwin, A. MacPherson, E. L. Pringle, May 22, 1918; M. Lowe, May 28, 1918; Capt. W. F. McIsaac, June 3, 1918.

Having been killed in action: Capt. D. E. Howes, May 19, 1918; Nursing Sister K. M. MacDonald, May 19, 1918.

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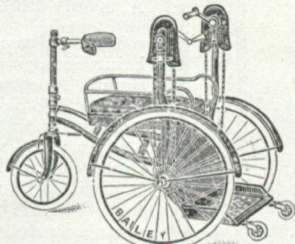
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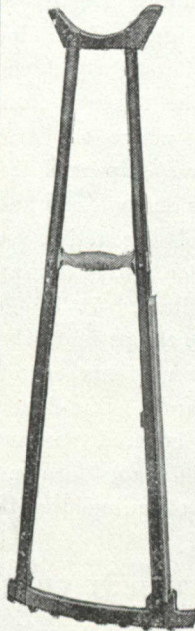
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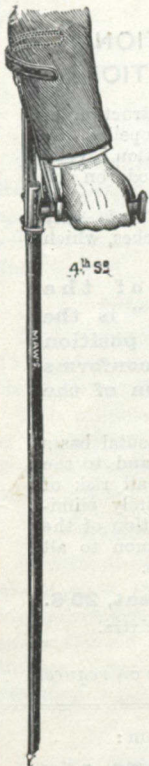
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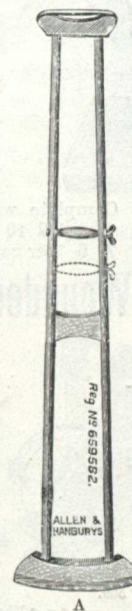
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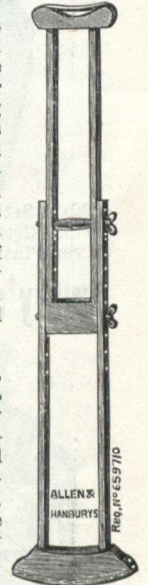
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