SOME OBSERVATIONS UPON THIRTY-ONE CASES OF MULTIPLE PERIPHERAL NEURITIS AMONGST EUROPEAN TROOPS IN INDIA.

By Captain R. C. Priest.
Royal Army Medical Corps.

During the hot season of 1912 in Lebong, near Darjeeling, a disease with a somewhat obscure origin became prevalent amongst the men of the 3rd Battalion Middlesex Regiment; the same disease, it appears, was observed in the previous year amongst the men of the same regiment and, as far as could be ascertained, it was found that some of those affected seemed to recover completely after spending the winter in the plains (Calcutta), others had a relapse the following year, while some of those who returned to England, time expired, found their way to the hospitals in London. Of the latter no record of their ultimate fate has been obtained. In 1911, the symptoms of the complaint so closely resembled those of beri-beri, that the first cases were actually diagnosed as such, but after investigation the name of the disease was changed to multiple peripheral neuritis. It will be seen that the symptoms about to be described simulate those of early beri-beri, and the report of one fatal case of disordered action of the heart will show how closely related the two diseases are.

It should be borne in mind that the regiment had recently come from Singapore, where, I am informed, beri-beri or a closely related disease is common among the native inhabitants.

Before discussing the aetiological factors of this disease, it would be well briefly to point out the general features of the Lebong Cantonment, and the rough sketch-plan attached will assist the reader to appreciate the surroundings of the Lebong Spur and the bungalows situated thereon. The barrack bungalows are situated on a spur of the North Eastern Himalayas, a spur which juts out in a north-north-east direction, and is one of the terminations of a long ridge extending from Senchal through Katapahar, Jalapahar and Darjeeling to Lebong. The bungalows lie on the summit and upon the eastern and western slopes at varying heights above sea level, the highest one occupied by soldiers being "F" Company lines 5,950 ft., the lowest being "D" Company lines 5,640 ft. and 5,610 ft. on the eastern slope, i.e., a difference of over 300 ft. vertically and about half a mile horizontally. Below the Eastern
NOTES.
1. Size of bungalows exaggerated.
2. Numbers on bungalows = heights above sea-level.
Lebong road there are tea gardens along the entire extent of the
cantonment, while below the opposite slope there is dense jungle
and forest, which serves as an efficient shelter from any breeze
ascending the slope. The grass and wormwood weed which sur­
round the bungalows grow luxuriantly during the rains. The
most northerly part of the spur is used as a training and manoeuvre
area, and here again jungle, long grass, scrub and forest are the
natural conditions. The prevailing wind comes from the south­
south-east, which brings with it rain and mist for the greater part
of the time. Although, it will be observed, the amount of sun
received by the bungalows would be about equal during the
day, the bungalows on the western slope are sheltered from
the south-south-east wind, and consequently the atmosphere is
much more "steamy." The difference in atmospheric conditions
between the two slopes is quite appreciable. The rainfall from
March to October, 1912, was approximately 130 in., while the day
temperature varied between 60° and 75° F. The humidity varied
from 75 to 100 per cent.

ÆTILOGICAL FACTORS.

These are discussed on the same lines as those described for
beri-beri in Sir Patrick Manson's textbook of "Tropical Diseases." Observations were made upon thirty-one cases in all, fifteen of
which were fresh and sixteen were old cases, i.e., cases which had
suffered during the previous year, but which had recovered suffi­
ciently to do their duty while in Calcutta for the winter months.

Age.—Cases ranged between 19 and 27 years. No cases occurred
amongst officers, non-commissioned officers, women and children.

Alcohol.—Five drank moderately at the time of observation,
10 had been heavy drinkers but were teetotallers while in the
Service, 7 had been moderate drinkers but were teetotallers while
in the Service, 9 had been teetotallers always.

These figures do not show that there is any relation between
the amount of alcohol consumed and the disease in question.

Venereal Disease.—Two cases had been treated for syphilis; 2
cases had suffered from gonorrhoea.

Smoking.—Curiously enough, the soldier who smoked most
heavily was one of the mildest cases. It might be said that
nicotine tends to increase the heart symptoms, but these were
very persistent even when the cases were kept in hospital.

Other Diseases.—The numbers which had been admitted for each
of the following diseases were:—
176 Observations upon Multiple Peripheral Neuritis

Malaria, 10; diarrhœa, 4 (hill diarrhoea); scabies, 1 (twenty-one days in hospital); influenza, tonsillitis and boils were entries in one patient's M.H. Sheet; while diarrhœa, dysentery, syphilis and malaria, were entries in another patient's M.H. Sheet. The last two cases were the worst and most resistant to treatment, showing that debilitating diseases tend to lessen the resistance to multiple peripheral neuritis.

Food.—It does not appear that the disease was connected with the food supply of troops, for, the rations being always of good quality and varied, the occurrence of these cases cannot be explained by the nitrogenous starvation theory. As regards rice, this was of the unpolished variety, and was not consumed in sufficiently large quantities to cause anxiety. Fresh vegetables were issued and the supply was varied. Cooking arrangements were satisfactory, and no utensils were "tinned." Unsound fish was never consumed, only reliable tinned fish from the coffee shop was procurable. There was not at any time any overcrowding in barrack rooms, and there was no prevalence of skin diseases such as scabies, pediculosis or any other parasitic diseases. Ventilation of the barrack rooms was insisted upon in all weathers.

The water supply was intermittent, and came from a catchment area at Senchal, being conveyed by pipes.

Symptoms.

These, it was found, divided themselves into two classes: (1) Leg symptoms; (2) heart symptoms.

Leg Symptoms. (a) Anaesthesia.—In seven cases there was anaesthesia over the front of the tibia on both legs, the area corresponding to the lower two-thirds of the surface supplied by the fourth lumbar nerve; in these cases a pin could, without causing pain, be pushed into the skin sufficiently hard to cause bleeding. From this area, also, hairs could be pulled out in bunches without discomfort. Thermal sensations were delayed, but not lost. In all these cases the skin appeared pale over the whole leg below the knee. In sixteen cases the areas of anaesthesia were patchy and appeared to vary in situation from time to time. In these cases there was delayed tactile and thermal sensation. In eight cases no anaesthesia could be detected at all. Finally, in none of the thirty-one cases was anaesthesia of the skin observed above the level of the knee.

(b) Knee-jerks.—In twenty-one cases this reflex was normal and
equal on the two sides; in two cases both knee-jerks were exagger­ated; in one case they were present but equally diminished, while
in two cases they were unobtainable, and these two cases were those
which presented complete anesthesia. The remaining five cases
showed the reflex to be present, but more exaggerated on one side
than the other; ankle clonus and Babinski’s sign were absent in all
cases.

e) Edema.—This was observed to be extremely variable both
in amount and distribution; in some cases there was distinct
pitting, in others the oedema was slight and transient. Its variabil­
ity in distribution was exemplified by the fact that on one day it
would be seen just below the knee, on the next just above the
ankle. The oedema was undoubtedly increased by exercise, but
the oedema of the cases treated in hospital and in bed did not easily
disappear. Both legs were oedematous in twenty-seven cases, with
one leg more affected than the other, while in four cases there was
no oedema at all.

d) Muscular Development.—In no case was there any wasting
noted, but, on the contrary, in those cases with much unilateral
oedema, the calf muscles resembled those of pseudo-hypertrophic
paralysis. The skin over the calf muscles never gave rise to
“pitting,” but the muscles themselves when grasped appeared firm,
and in eleven cases gave rise to pain on being squeezed. One case
exhibited enormously enlarged and tender gastrocnemius muscles.
Unfortunately, it was not possible to examine the reaction for
degeneration.

e) Ataxia.—The majority of cases complained of numbness
and stiffness of the legs, with a liability to stumbling over projecting
stones, &c. Some said that their legs “gave way” occasionally.
Romberg’s sign, however, could not be obtained, and co-ordination
appeared normal in the thirty-one cases.

(f) General Condition.—In every case the body covering was
good and localized wasting was not observed.

Heart Symptoms.—The more severe heart affections led one to
suspect a right-sided dilatation following upon hypertrophy of the
heart as a whole. In some cases the countenance was anxious, in
some cyanosis was present, in others there was throbbing in the
neck and every heart-beat seemed to shake the body, while in the
more severe cases all the above symptoms could be seen. On
inspection of the chest one noticed a diffused cardiac impulse and
distinct epigastriac pulsation. On palpation there was a rapid and
irregular impulse, while on auscultation, the heart sounds were heard
Observations upon Multiple Peripheral Neuritis

to be irregular, the first sound being short, flapping in character and hard to distinguish from the second, unless the apex was palpated simultaneously. There was in many cases a murmur, systolic in time, heard best at the base and not conducted upwards or outwards towards the axilla. On percussion, the heart was found to be enlarged both to the left and to the right, and the impulse much lower than normal. All grades from the severe to almost normal type were observed in the series. Eighteen cases showed right-sided enlargement associated with hypertrophy of the left ventricle in five; in thirteen cases there was only slight enlargement to the right. In eighteen cases epigastric pulsation was distinct, while in twenty-seven cases the pulmonary second sound was reduplicated, this being one of the most frequent signs noted, and it appeared quite early in the disease. In one of the most severe cases, the heart’s impulse failed to reach the radial pulse. Lastly, it was observed that the signs of a disordered action were primarily an increase in the number of beats, soon followed by irregularity of action.

I should like to mention that it did not necessarily follow that, because a man showed much oedema, the heart symptoms would be severe, for in some of the cases with large irregular hearts the oedema, anaesthesia and interference with reflexes of the legs were comparatively slight. It would seem therefore that the cause of this peripheral neuritis exhibited a selective action. Precordial pain was another feature in many of the cases, and shortness of breath upon the slightest exertion was a symptom frequently complained of.

The Blood.—Examination of the blood-films of those in hospital showed a slight leucocytosis, with a relative slight increase in the mononuclear variety. Blood taken from a vein and planted into ox-bile medium was found to be sterile in every case.

The disease, as far as one observed from the eight cases in hospital, was perfectly afebrile and at no time did the symptoms suggest an acute infection.

In one of the cases, herpes appeared upon the right flank, in the region of skin supplied by the tenth thoracic nerve; there was no anaesthesia noticed, however, except in the legs, but in this case the heart symptoms were severe.

The Question of Infectivity.

When the battalion returned from Calcutta in the spring of 1912 the companies were distributed differently. “A” Company,
for instance, in 1911 occupied the lines which were allotted to "G" Company in 1912; this makes explanation difficult, and so, for the sake of clearness, the 1912 disposition is considered as the fixed one.

The following table will perhaps help to bring out the points with more clearness:

<table>
<thead>
<tr>
<th>Company lines, 1912</th>
<th>Number of cases attending, 1912</th>
<th>Fresh cases, 1912</th>
<th>Lines occupied by 1911 cases &quot;G&quot;</th>
<th>Number of cases, 1911</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;A&quot;</td>
<td>11</td>
<td>6</td>
<td>i.e., 5 cases in &quot;A&quot; Company arose while this Company was occupying the present &quot;G&quot; lines</td>
<td></td>
</tr>
<tr>
<td>&quot;B&quot;</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>&quot;C&quot;</td>
<td>2</td>
<td>1</td>
<td>&quot;B&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;D&quot;</td>
<td>2</td>
<td>2</td>
<td>&quot;D&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;E&quot;</td>
<td>2</td>
<td>1</td>
<td>&quot;D&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;F&quot;</td>
<td>5</td>
<td>1</td>
<td>&quot;E&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;G&quot;</td>
<td>6</td>
<td>3</td>
<td>&quot;A&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;H&quot; (Barrackpore)</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Qr.-Mr. Stores</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Drums</td>
<td>1</td>
<td>0</td>
<td>Qr.-Mr. Stores</td>
<td></td>
</tr>
<tr>
<td>Cases untraced</td>
<td>1</td>
<td>1</td>
<td>Drums</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>15</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

From the table it appears that "A" and "G" Company lines, were the ones principally concerned in the outbreak of disease in 1911, and as in 1912 most of the fresh cases arose in these two lines, it seems possible that the disease spread either by contact or because of the presence of neuritis houses. The conditions prevailing at these sites appear to foster the disease, as in "F" Company lines; although there were four cases from other bungalows, only one fresh case arose in 1912. "F" Company lines, it may be argued, did not prove favourable to the spread of the disease owing to their situation. "B" Company lines, although they gave rise to one case in 1911, gave rise to no cases in 1912, while the other lines, "C," "D," "E" Companies, seem to be intermediate not only in fostering the disease, but also in being factors in the origin of the disease. In 1912 "B" Company lines had no cases, for the one case in 1911 had been removed. No fresh cases resulted. Compare this with the other lines, and it is seen that wherever old cases lived, new cases arose, which suggests a possibility of direct infection from case to case.
I was informed by some of the patients who had been in hospital in Calcutta, that other patients in hospital at the same time had contracted the disease from the neuritis cases. Again, I heard that some men of a company of the regiment from England (the 2nd King’s Own) stationed at Barrackpore had contracted neuritis from two cases in the 3rd Middlesex Regiment who were left behind after that battalion had proceeded to Cawnpore.

During these months there was one case, not included in this series, which was admitted to hospital for disordered action of the heart. He had suffered on and off with precordial pain, palpitations and shortness of breath. On admission, it was found that he had a previous admission for multiple peripheral neuritis in 1911. On examination, there was throbbing in the neck, a facial expression denoting distress, very distinct epigastric pulsation and a diffuse cardiac impulse. The heart’s impulse was well below and outside the normal limit, and was very rapid and irregular. The anterior cardiac dulness was greatly increased and extended to about three-quarters of an inch beyond the right sternal margin. Some of the beats did not reach the radial pulse, and on auscultation the heart sounds followed one another in rapid succession; the first was weak and flapping in character; there was a short bruit which was not conducted and which was systolic in time. The lungs were carefully examined, but they appeared to be healthy. The liver and spleen were not enlarged, and there was no free fluid in the body cavity. There was no oedema of the legs, the knee-jerks were normal and there was no anaesthesia. The urine was normal and no casts were found. He was kept in bed and given a mixture of digitalis and strychnine, together with hot fomentations to the chest. For a few days he seemed to improve, but one morning he complained of great pain over the ensiform cartilage; great difficulty in breathing was evident by the obvious action of the accessory respiratory muscles and by cyanosis. At intervals he coughed up a good deal of frothy blood-stained and watery-looking fluid. Examination of the chest showed bilateral dulness at the base, with diminished breath sounds which gave one the impression of acute oedema of the lung and some exudation of fluid into the pleural cavities. He was given an injection of digitalin. He seemed to be easier, but there was still great cyanosis which necessitated venesection; nearly eighteen ounces were withdrawn from the right median basilic vein. Injections were continued and a free saline purge was administered, but he grew rapidly worse; the pain and distress increased until he succumbed. At the post-mortem exam-
R. C. Priest

inflation free fluid, pale green in colour and quite clear, was found in the pleural cavities; there were no recent adhesions, but some old ones at the right apex. The lungs were very dark and firm; on squeezing, a large quantity of frothy fluid exuded but there was no consolidation. There was an unusual amount of free fluid in the pericardial sac, the heart was seen to be enlarged, especially to the right. The left ventricle showed signs of hypertrophy. The right ventricle was filled with blood, the wall was thin and exceedingly soft, so that the fingers could be pushed through the muscular substance with ease. The same condition was also observed in the muscle of the left ventricle. The liver was not enlarged; the spleen was of normal size and did not appear to be congested, although it was soft in consistence. There was no free peritoneal fluid. The legs were not oedematous.

This case presented features which are analogous, if not identical, with those of sudden death from beri-beri due to rapid hydrothorax and pulmonary oedema.

The man, in my opinion, suffered from disordered action of the heart as a result of his previous attack of neuritis in 1911, which had permanently deranged the cardiac nerve endings, presumably those of the vagus. If this be the case, then this form of multiple neuritis is very closely related to beri-beri, and the difference is mainly one of degree.

**Treatment.**

The treatment of these cases in Lebong, it must be confessed, was unsatisfactory, and was, of necessity, symptomatic in character. It has already been observed that the cases which arose in 1911 recovered from their disability when they went to Calcutta for the winter, and very little drug treatment appeared necessary. Again, when the regiment left Lebong for Cawnpore, the majority of men shook off their disease, and upon inquiry from the medical officers at that station a year later (1913), it was reported that physical signs persisted in only two of them; the sign remaining being tachycardia. This evidence seems to show that removal of the affected individual from an area where peripheral neuritis is prevalent is the best method of treatment.

For those patients with rapid and irregular heart’s action, I found that a mixture of digitalis, liquor strychnine and atropine, along with a belladonna plaster locally, was successful in combating the symptoms. The worst cases were admitted to hospital, and were kept at rest.
The cases presenting oedema and anaesthesia of the legs seemed to be relieved by local applications of glycerine of belladonna, Scott's dressing, or hot fomentations followed by massage and the electric battery. Even with rest and local applications the oedema and anaesthesia were aggravatingly persistent. Such drugs as quinine, iron and arsenic, had not the slightest effect. Although there was nothing to indicate a metallic poisoning and subsequent neuritis (e.g., blue line on the gums) the sulphate and iodide treatments were adopted, but no improvement was noted in the cases undergoing this regime.

GENERAL REMARKS.

We have before us a definite disease which is prone to affect the soldiers in a garrison, while officers, non-commissioned officers, women and children appear to be peculiarly free from the disease. Putting aside for a moment the question of infectivity by contact, it was thought possible that cases might have arisen from some source common to soldiers, and one which would not affect officers, non-commissioned officers, women or children. Some form of metallic poisoning might account for the neuritis, and so these possibilities were investigated.

The coffee shop tea supply was considered first. The tea was made by boiling municipal water (from Senchal) in large metal chatties, and either fresh separated milk or more frequently condensed tinned milk was added. The tea was served either direct from the chatties in the supper room, or was conveyed round barracks in tin cans, served out to soldiers by means of a tin ladle. Officers, non-commissioned officers, women and children never made use of this supply. The large chatties were never re-tinned, and the possibility of the entrance of metallic elements was not lost sight of. The tinned milk looked quite good. But as there were no means of examining the water or the condensed milk or the final tea after boiling in the chatties, for the presence of tin, lead or antimony, &c., quantitatively or qualitatively, nothing can be said for or against the theory.

The mineral waters were made in the soda-water factory using water from the municipal supply, and were consumed by officers, non-commissioned officers, women and children, and it is therefore improbable that these beverages were to blame. It might be said that the cases were "cardiac" cases, i.e., the result of heart-strain with dilatation. If so, it at once becomes difficult to account for the
R. O. Priest

anaesthesia, the loss of knee-jerks in some cases and exaggeration in others, the variable oedema in the legs and oedema with very slight affection of the heart. At the same time it must be confessed that the condition became aggravated by exercise, and this was well exemplified by the fact that the greatest number of cases came to light during field training and during the time when running parades were in force. I believe that the disease was present and that exertion aggravated it to such an extent as to call the men's attention to its existence.

It has been observed that most cases arose during field training or very soon afterwards. In the rainy season grass and weeds grow luxuriantly, and it is impossible to walk a short distance through this without finding a large number and a great variety of leeches upon one's boots and putties. It was therefore thought that the poison of multiple peripheral neuritis was injected by means of the leech bites, because upon inquiry almost every man suffering from the disease had been bitten. Experiments were tried by Major Bennett, R.A.M.C., to produce the disease in a goat by means of an extract from a collection of leeches and also by direct application of live leeches. No signs of the disease in the goat resulted. It was observed that the skin round a recent leech bite was anaesthetic in one of the soldiers affected by the disease.

Finally, if peripheral multiple neuritis is an infectious disease, as there are some grounds to believe it is, we ought to find evidence of it elsewhere. It is, I think, certain that a disease of a similar nature is prevalent amongst tea-garden coolies in the immediate vicinity of cantonments. This disease tends to run through families and many families are affected. Some die, and from all accounts the mode of death is the same as in the fatal case reported above. The cases show rapid heart's action, oedema over the tibiae, affection of the knee-jerks, a systolic bruit (not conducted) and accentuated pulmonary second sound. Pyorrhoea, and in one case a blue line, was present; in another case there was ascites without oedema of the legs.

In cantonments there was a native porter who showed a great amount of oedema over the tibiae, with well marked anaesthesia, but he was able to carry heavy loads up the hill-sides with apparently very little cardiac distress.

Furthermore, one dog was brought to me because of shortness of breath, the heart's action and sounds were comparable to those in affected human beings; this dog began to bring up a frothy
fluid from the chest and died. Previous to death both lungs were dull on percussion. Another dog was seen with a swollen abdomen due to ascites. At the autopsy the peritoneal cavity was full of a pale yellow fluid and no inflammatory lesion could be found in the abdominal organs. The chest also was full of fluid. The heart sounds before death appeared normal. The liver was not enlarged, nor was the spleen.

If the symptoms quoted amongst natives are those of multiple peripheral neuritis, then it can be fairly said that the disease is endemic in Lebong. Moreover, since cases have arisen in Barrackpore and in Calcutta it is quite likely that the disease is endemic in Bengal. The fact that, as far as one knows, no fresh cases have arisen in Cawnpore, and the men who went to Cawnpore have quite recovered, seems to accentuate the difference between Bengal and the United Provinces. Civilian practitioners know of this disease amongst coolies in the large Darjeeling district, and it is termed ‘beri-beri’ by them. But, if the disease in Europeans and Natives is identical it becomes hard to realize by what means the poison is conveyed from one to the other, and it was hoped that the leeches would prove to be the intermediaries.

It will be interesting to observe if the men of the 2nd King's Own Regiment become attacked by the disease during their service in Lebong. The battalion is made up of men from the 1st Battalion recently at Lucknow, and of those who have come direct from England. Had not the circumstances of the Service necessitated one company of the regiment going to Barrackpore, where some of the Middlesex cases of multiple peripheral neuritis remained, the regiment would have commenced its service in Lebong with an absolutely clean sheet.

I am informed that about half a dozen cases made their appearance in this company at Barrackpore, and as this company has since arrived in Lebong there is some possibility of an importation of the disease from that source. Had the regiment as a whole come to Lebong, and had any cases arisen subsequently, it would have gone a long way to prove that the disease of multiple peripheral neuritis is endemic in Lebong and that it can be contracted without the presence of existing cases amongst Europeans residing within cantonment limits.

At any rate the disease is a very important one because it causes the complete disability of the soldier for a long period.

The soldier so affected cannot march, cannot perform his physical exercises, and his shooting is interfered with, partly
because he is unable to march to the range, and secondly, the rapid and forcible heart's action, when he does reach the range, makes his aim inaccurate.

At the end of the summer season some twenty men were quite unable to march down to Siliguri with the battalion and they were compelled to go by rail because of their disability.

In conclusion I would like to express my thanks to Major G. M. Goldsmith, R.A.M.C., and to Major Bennett, R.A.M.C., for their kind assistance and many suggestions.