NOTES ON THE CASE OF No. 7560, SERJEANT C. S., 1ST BATTALION, THE SUFFOLK REGIMENT.¹

By Captain R. G. ARCHIBALD.
Royal Army Medical Corps.

Service seven years three months. Stationed in Khartoum since January, 1914; previously served in Alexandria. Admitted to hospital on the evening of September 24, 1914. He was a regular beer drinker, but there was no evidence to show that he drank to excess, and also a heavy smoker. He was orderly-room clerk, and had noticed swelling in his legs two months before, but did not report sick until on getting up off his bed he fell down, his legs giving away under him.

On Admission.—Temperature was 103° F. He had symptoms of multiple peripheral neuritis in the legs and some signs of it in the upper limbs. Knee-jerks absent. There were anaesthetic areas over the calves in both legs and in the tips of the fingers; he could not hold or pick up anything. Foot-drop was present. The heart was disordered in action, rate 120, with marked reduplication of the first sound over the mitral area. The muscles were flabby, and tenderness was present in the calf and hamstrings. At first the disease was thought to be alcoholic neuritis with disordered action of the heart due to nicotine.

On October 6 he was worse; both wrist-drop and ankle-drop were well marked, and he had òedema of the legs and back.

On October 12, paresis, pressure tenderness and òedema were more marked; the heart's action was very rapid and a systolic bruit present.

On October 13, the tongue became excessively swollen, so much so as to cause great obstruction in swallowing, and some to respiration; it was incised to relieve the swelling.

On October 14, death occurred from exhaustion.

Post-mortem Examination.—Rigor mortis well marked. Body warm, face, chest, and upper arms deeply cyanosed. Òedema of legs and all dependent parts. Stomach and intestines distended with flatus, ascites about two ounces. No enlargement of liver, but in section well-marked "nutmeg" appearance. Spleen eight ounces in weight, normal in appearance; kidneys normal. Lungs healthy except for òedema, no pleural exudation. Pericardium contained two ounces of fluid. Heart enlarged and dilated, right side distended with black clot. Piece of ileum, liver, sciatic nerve and posterior tibial nerve sent to Wellcome Tropical Research Laboratories, Khartoum, for pathological report.

¹ Extracted from notes by Captain A. P. O'Connor, R.A.M.C., up to September 26, 1914, and by Captain J. F. Farrow, R.A.M.C.(T.) from that date onwards.
Clinical and other Notes

PATHOLOGICAL REPORT ON THE POST-MORTEM SPECIMENS OF SERJEANT C. S., THE SUFFOLK REGIMENT.

The Senior Medical Officer, British Troops, forwarded to these laboratories the following specimens for examination and report:—

(1) Portion of the liver.
(2) Portion of the small intestine, in the region of the ileum.
(3) Portions of the sciatic and posterior tibial nerves.

Microscopical Character of the Specimens.

(1) Liver.—The specimen sent was firm and of a deep red colour. On section it presented a mottled appearance and the typical characters of a “nutmeg” liver. Examination of the cut surface showed minute areas of a deep red colour, which corresponded to the central parts of the lobules, and these were surrounded by zones of a greyish-yellow colour.

(2) Sciatic and Posterior Tibial Nerves.—They appeared to be slightly swollen and reddish in colour, but apart from this there were no marked pathological changes apparent.

(3) Ileum.—In the lower part of the ileum there were two areas of the mucous surface which showed a well-marked and definite hyperæmia, the centres of which represented minute ulcers with irregular edges. These were adjacent to a Peyer's patch. The peritoneal surface over these areas was slightly congested, but no evidence of perforation was present.

Portions of these specimens were cut into small blocks and placed in various fixing fluids such as formol-alcohol, Schaudinn’s fixative, and Orth’s fluid, and were finally embedded in paraffin. Longitudinal and transverse sections were cut, and in order to study their histopathology various staining methods were employed.

Liver.—In sections stained by hæmatoxylin and eosin the central vein of each lobule, and the capillaries leading to it, were seen to be dilated and filled with blood. The liver cells between the dilated capillaries were atrophied, distorted and compressed, and many showed a granular appearance and were devoid of nuclei.

In certain areas the liver-cells had undergone complete necrosis. Scattered throughout the liver substance there were homogeneous masses round and oval in shape and of a yellowish colour. They measured ten microns in diameter, and were surrounded by a clear unstained halo which appeared to represent a capsule.

These homogeneous masses showed but little differentiation in structure. Some were found to possess knob-like projections, or buds, on their sides and under surface (fig. 1) and in one case the bud had extended into a thick branching filament along which the clear and unstained halo had extended (fig. 2). This afforded conclusive evidence
Fig. 1.—Liver, showing homogeneous mass with double contour. Note the projection or bud arising from the side of the mass. x 1,700.

Fig. 2.—Liver, showing thickened mycelial filaments arising from a homogeneous mass. Note the branching and the halo continued along the line of the filaments. x 1,700.

Fig. 3.—Liver showing dense aggregations of spores which assumed yeast-like forms. x 310.

To illustrate "Notes on the Case of No. 7560, Serjeant C. S., 1st Battalion, The Suffolk Regiment," by Captain R. G. ARCHIBALD, R.A.M.C.
Fig. 4.—Liver. Section of a blood-vessel with branching or budding spores giving a "monilia"-like appearance. These spores are occupying the centre of the lumen of a vessel. x 1,700.

Fig. 5.—Longitudinal section of the ileum in the vicinity of one of the ulcers, showing the fungus in situ. Note the hypha bearing grape-like clusters of spores at the terminal end (acrogenous conidia). Lateral spores (pleurogenous conidia) are also seen. x 1,700.

Fig. 6.—Ileum showing a hypha-bearing conidia. x 1700.

that the homogeneous masses were fungal in origin. They were present in the liver-cells, macrophages, and in the lumen of the dilated capillaries.

In Leishman-stained specimens they acquired a greenish-yellow tinge, and by this method of staining it was possible to demonstrate the extensive nature of the infection in the liver.

In Gram-stained sections further elements connected with this fungus were evident, particularly in the areas where necrosis of the liver-cells had occurred. In these areas numerous spores or microconidia were present. They occurred either discrete, or arranged in single chains of two to five elements, or in dense aggregations (fig. 3).

They were round in shape and yeast-like in appearance. They retained Gram's stain, and were provided with a thick wall which enclosed a less intensely stained area in which no vestige of a nucleus or any other structure was apparent. Some of the older forms showed a clear central area with a faintly stained rim.

These conidial elements were small in size, and measured one micron in diameter. Their occurrence in chains apparently resulted from a process of budding (fig. 4). They were located in the liver-cells, and in the lumen of the capillaries and larger vessels, and were also present in the macrophages where they had apparently been phagocyted.

Ileum.—Sections were made in the vicinity of the ulcers. Haematoxylin-eosin stained specimens showed that the villi in the affected areas had undergone almost a complete necrosis. Lying in the necrosed tissue were dense masses of fungal elements. They were present in the form of hyphal filaments and conidia, and were recognized by their blackish-brown colour. The density of some of these masses rendered the recognition of the individual elements somewhat difficult, but close to them there were usually found discrete hyphae bearing acrogenous and pleurogenous conidia (fig. 5). These hyphae and conidia were also present in the crypts of Lieberkühn and in the submucous tissue. Many of the conidia were lying free or in grape-like clusters, and it was of interest to note their presence in the lumen of the blood-vessels of the submucosa.

The conidia were circular in shape and varied in size from one to six microns in diameter. They were dark in colour but usually possessed a clear pin-point centre. The conidium itself was provided with a double-rimmed envelope which in turn was surrounded by a clear unstained halo.

When the conidia occurred in an acrogenous position they appeared in clusters of two, four, six, eight or more elements "set" on somewhat expanded ends of hyphal filaments (fig. 6). No such intermediate elements as sterigmata were found. In the same manner the lateral conidia appeared to be attached direct to the hyphae.

The hyphae were usually non-segmented, and were provided with thick
walls which enclosed a clear interior. Some of the older hyphae showed segmentation.

There was no very marked cellular infiltration in the vicinity of the fungus. Its presence in the mucous surface of the bowel appeared to excite a necrotic effect. No other organisms were found. Crystals of calcium oxalate were noted in certain parts of the affected areas.

The capillaries of the submucosa were dilated and distended with red blood corpuscles; some also contained conidia.

Nerves.—Longitudinal sections of the sciatic and posterior tibial nerves showed that degenerative processes were present affecting chiefly the medullary sheath of the nerve-fibres.

These degenerative changes were best demonstrated in sections stained by Marchi's fluid, which well illustrated the breaking up of the myelin into a granular mass consisting of fat globules (fig. 7). The inner boundary of the medullary sheath was ill defined. The axial fibres also shared in this disintegration, and in certain areas the nuclei of the neurolemma showed proliferation. In short, the histological changes present were typical of a parenchymatous neuritis.

In transverse sections stained by Gram's method an interesting condition was present in the perineurium. In this area the lumen of several of the blood-vessels was found to be occupied by spores or conidia, indeed, some of them were apparently plugged by thrombi composed of fibrin and conidia (fig. 8). These conidia retained Gram's stain and morphologically were identical with those found in the liver and intestines.

**Remarks.**

From the examination of the material obtained there can be no doubt that a systemic infection with a fungus was present, and *ipso facto* it was the *causa causans* of the patient's malady.

The microscopical evidence tends to show that the infection was obtained via the intestinal tract, and that the initial lesion commenced in the ileum in the form of an ulceration set up by the presence of a fungus.

The photomicrographs illustrate (a) the fungus *in situ* in the intestinal lesions; (b) a mycelium and spores of the fungus in the liver; (c) spores of the fungus in the blood-vessels supplying the sciatic and posterior tibial nerve.

Such evidence is sufficiently conclusive to warrant the diagnosis of a "mycosis" being made.

Unfortunately, as the condition was not suspected, neither culture nor animal experiments were carried out to determine the species of fungus present, consequently it was only possible to determine the fungus somewhat arbitrarily from its morphology as seen in the tissues, and more especially in the intestinal lesions. In the latter it appeared to possess
FIG. 7.—Longitudinal section of the sciatic nerve, stained by Marchi's method. The dark areas represent the medullary sheath breaking up into fat globules. The axial fibres have almost entirely disappeared. × 940.

FIG. 8.—Sections of blood-vessel in the perineurium of the sciatic nerve, showing thrombi composed of spores and fibrin. Note that the lumen of the vessel is almost completely occluded. × 1,050.

FIG. 9.—Ileum, showing the fungus in situ in the base of the ulcer. × 620.

characters which would allocate it either to the genus Endomyces or the genus Sporotrichum.

**SOURCE OF INFECTION.**

The evidence obtained from the examination of the specimens points to an alimentary infection caused by the ingestion of food or water containing the fungus.

Many fungi occur as saprophytes on plants and animals, and it is of interest to note that the genus Sporotrichum has been found saprophytic on lettuces and other vegetables used for salads. It is quite possible that the infection in this case may have resulted from the consumption of uncooked, infected or decomposing vegetables, but the question is too hypothetical to be discussed further.

The case appears to be worthy of record inasmuch as it is the first one in the Sudan in which evidence has been obtained of a systemic infection with a fungus. Further, the clinical history of the case and its marked similarity to beri-beri gives additional interest to it. Clinically, the case was typical of beri-beri, and the lesions present in the sciatic and posterior tibial nerves were identical with those found in the disease. The histopathology of the liver and ileum corresponded more or less to that described in beri-beri.

Unfortunately, for reasons already stated, neither animal nor cultural experiments were carried out. They may or may not have afforded conclusive proof.

The theories held regarding the various causes of beri-beri are legion, for the etiological factor has yet to be determined. In the eyes of most observers the theory that beri-beri is caused by some vegetable parasite apparently carries little weight, but in the writer's opinion more researches are required to definitely rule this theory out of count, particularly in view of the evidence recorded in this case.

Owing to the lack of experimental evidence one may sum up this case by describing it as a mycosis which resembled beri-beri in its clinical and pathological features.

My thanks are due to Captain Farrow, R.A.M.C., Senior Medical Officer, British Troops, for the specimens sent and to Mr. N. Macdonald, Bacteriological Assistant, for the photomicrographs.